A COMPARATIVE STUDY OF DOD AND CIVILIAN HOSPITAL INVENTORY MANAGEMENT SYSTEMS

THESIS

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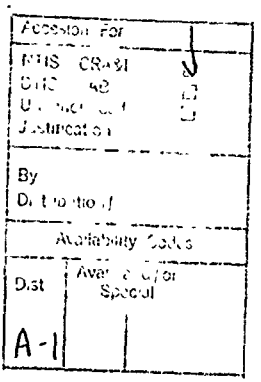

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THESIS

Presented to the Faculty of the School of Systems and Logistics of the Air Force Institute of Technology Air University In Partial Fulfillment of the Requirements for the Degree of Master of Science in Information Resource Management

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Preface

The purpose of this study was to conduct a comparative analysis of Department of Defense and civilian hospital inventory management systems. The literature review conducted led to the development of measurement questions which were used in personal interviews of respondents at three hospitals: one US Air Force, one US Army, and one civilian. The results of the interviews were assembled, analyzed, and conclusions regarding the inventory management systems studied were derived.

The completion of this thesis would not have been possible, were it not for the assistance and guidance of many individuals. I would particularly like to thank LTC John Clarke for his initial advice in developing this research topic. I will be forever indebted to Lt Col Phillip E. Miller for his steadfast guidance and patience as my thesis advisor. His insight and skill continually nourished my desire to conduct this thesis research. I would like to thank the logistics staffs of Wright-Patterson Medical Center, Kettering Medical Center, and Evans US Army Community Hospital for their cooperation in conducting the interviews and providing pertinent documentation on the inventory management systems at the respective organizations. For her direction and assistance in developing the final draft of this report, I extend

gratitude to Mrs. Jonna Lynn Hamrick. Ultimately, I would like to thank my husband, Roger and my son, Preston, for bearing with me during many hours of solitude. As a result of their understanding, the strength of the bond our family experiences has grown.

Karen A. Lemay

Table of Contents

Page

List of Figures

List of Tables

Abstract

The purpose of this thesis was to determine if one method of inventory management would standardize procedures and minimize costs for Department of Defense and civilian hospitals. This was accomplished by conducting a comparative analysis of inventory management systems used at Wright-Patterson Medical Center, Wright-Patterson Air Force Base, Dayton, Ohio; Kettering Medical Center, Kettering, Ohio; and Evans US Army Community Hospital, Ft. Carson, Colorado.

The literature review examined various inventory management methods used for both general and hospital-specific inventories.

The measurement instrument developed to gain information on the specific inventory management systems used at the three hospitals was an open-ended questionnaire. The conceptually clustered matrix was selected as the methodology to conduct the analysis.

The thesis concluded that, although different automated systems were used at the three hospitals studied, the basis of each inventory management system was Economic Order Quantity (EOQ). The changes desired by all the individuals interviewed were in the user interface to the automated systems, not in the method by which inventories were

Cont from ix

maintained. EOQ is a satisfactory method of inventory management for DOD and civilian hospitals.

A COMPARATIVE STUDY OF DOD AND CIVILIAN HOSPITAL INVENTORY MANAGEMENT SYSTEMS

I. Introduction

General Issue

The task of supply management within the setting of a medical facility is very demanding. Many internal and external factors impact upon a systematic approach to maintaining adequate supplies for the least cost. In the current atmosphere of a declining federal budget, cost becomes a major concern in every aspect of supply management, to include the area of inventory management. The fluctuating demand for medical supplies further complicates automation of medical supply inventory systems. Within the Department of Defense (DOD) hospitals, there are a variety of methods used to manage medical supply inventories.

Justification

The United States Department of the Army Surgeon General, Health Care Logistics' office, expressed a desire for a thorough examination of the current inventory management system to determine if improvements could be made. If improvements are realized, this should ultimately allow inventory managers to obtain improved effectiveness

and reduced costs, and to parallel the changes in the defense budget.

Research Objective

In order to examine the current inventory management systems, this researcher will conduct a comparative study of the systems used at one US Air Force, one US Army, and one civilian hospital. The results of this study will allow for a determination of whether one most efficient and effective inventory management system exists, or if any modifications to existing systems would improve efficiency and effectiveness.

Specific Research Question

With several inventory management systems currently used by DOD and civilian hospitals, can one method be found which would standardize procedures and minimize costs?

Investigative Questions

In order to answer the specific research question stated above, the following investigative questions must be answered.

Question 1. What inventory management systems are currently used in logistics divisions of DOD hospitals and in materiels management offices of civilian hospitals?

Question 2. How do inventory management systems measure both efficiency and effectiveness?

Question 3. How do the inventory management systems differ?

Question 4. If least cost is not maintained, where does management feel that improvements could be made?

Definitions

It is imperative that the following terms be identified and defined in order for the reader to have a clear understanding of the terminology used in this thesis.

DOD. This term refers to the Department of Defense, which includes the US Air Force, the US Army, and the US Navy.

KMC. This is an acronym for the Kettering Medical Center, which is comprised of (KH), Kettering Memorial Hospital, Kettering, Ohio, and (SH), Sycamore Hospital, Miamisburg, Ohio.

Lead Time. Lead time is defined by Ammer as the amount of time between recognition of need for an item and receipt of that item (1:201).

Order-Point. An inventory control system which is regulated by the period between orders, and in which the order quantity is fixed (1:228).

Order Quantity. Order quantity is that amount of material which is ordered to replenish stocks on hand.

Periodic Reordering. This inventory control system is the opposite of an order-point system. Under periodic

reordering, the period between orders is fixed, and the inventories are regulated by the quantity ordered (1:223).

Reorder Point. The level of inventory at which an order for replenishment of stocks is placed.

Safety Stock. Safety stock is defined as extra inventory which "is needed to protect against unreliable forecasts" (1:203).

Stockout. Stockout is a condition in which fluctuations in lead times for replenishment or usage of an item cause depletion of the item (1:202).

Inventory Turnover Rate. The number of times that inventory is required to be replenished within a specified period of time.

Scope and Limitations

This research effort will be limited to review of only US Air Force and US Army CONUS-based military medical treatment facilities, and civilian hospitals. A US Navy medical treatment facility will not be studied. More specifically, the three hospitals under investigation are Wright-Patterson Medical Center, Wright-Patterson Air Force Base, Dayton, Ohio; Evans US Army Community Hospital, Ft. Carson, Colorado; and Kettering Medical Center, Kettering, Ohio.

Summary

This chapter identified both an area for potential improvement and for a decrease in costs in hospital logistics. In addition, a justification, specific investigative questions, and some important definitions have been included. The remaining chapters will attempt to provide answers to the investigative questions. Chapter II will provide a review of current literature, including a discussion of various inventory management methods in use; a review of the inventory management systems used at both the US Air Force and the US Army hospital, as well as the civilian hospital inventory management system; and a discussion of the factors used to measure inventory efficiency and effectiveness. Chapter III will discuss the measurement instrument designed to gather answers to the measurement questions derived from the investigative questions, the population from which the responses were obtained, and the data collection process. In addition, a thorough explanation of the analysis which will be used in examining the data will be included. Chapter IV will describe the analysis of the responses and the data collected, and Chapter V will provide a discussion of the findings and recommendations, as related to the specific investigative questions stated earlier in this chapter.

II. Literature Review

Introduction

This literature review is intended to enumerate some of the current strategies that are assisting managers to increase performance in the area of logistics management. This will be accomplished through the identification of various logistical inventory management methods. In addition, a review of factors which contribute to measuring inventory effectiveness will follow. The specific inventory management methods used at the three hospitals under investigation will be fully described, based upon literature provided by the hospital materials managers. A summary of the contents of Chapter II will conclude the Literature Review.

Basic Inventory Management Systems

A variety of inventory management systems exist today. In this section, four of the more commonly used systems will be discussed. They are the two-bin system, the perpetual inventory system, the ABC inventory system, and the economic order quantity system.

Two-Bin System. According to Dean Ammer, in his book entitled Materials Management, the two-bin inventory management system "is the oldest and simplest system of inventory control" (1:210). Under this method, one bin is

used to store inventory equal to that amount which would normally be used during lead time, in addition to an appropriate amount of safety stock. The second bin is used to hold the remaining inventory. "When the stock in the second bin is used up, the order point is reached" (1:210). At this point, the required quantity of stock is ordered, and the stockage from the first bin is used. As soon as the requested stock is received, the bin holding the lead time and safety stock is replenished to its former level, and any remaining stock is placed in the first bin for current use. Ammer states, "the two-bin system is best suited for items of low value, fairly consistent usage, and short lead time" (1:210). Ammer concludes his discussion of the two-bin system by providing some common uses for this inventory management system, such as office supplies.

Perpetual Inventory System. "The two-bin system actually is a primitive version of a conventional perpetual inventory control system" (1:210). Ammer continues by clarifying the difference between the two-bin system and the perpetual inventory system. He states that the perpetual inventory system does not require a separation of the stock, as there are records maintained which depict the amount of lead time and safety stock necessary, as well as the reorder point. The card maintained for the inventory items shows all transactions affecting the inventory level: issues, receipts of supplies, and quantities on order. With this

system, the records show the quantity on hand, as well as the quantity on order. In this manner, the total value of inventory can be calculated easily (1:211). The perpetual inventory system is commonly used by companies for maintaining production parts.

> While the perpetual inventory system is much more expensive to operate than the two-bin system without records, its cost usually is more than justified for relatively valuable items subject to losses from pilferage (1:211).

According to Ammer, the perpetual inventory and two-bin systems are inventory systems based on a fixed reorder point. In these systems, a fixed quantity of stock is ordered when the quantity of inventory drops to a predetermined level. The stocks fluctuate as depicted in Figure 1, below.

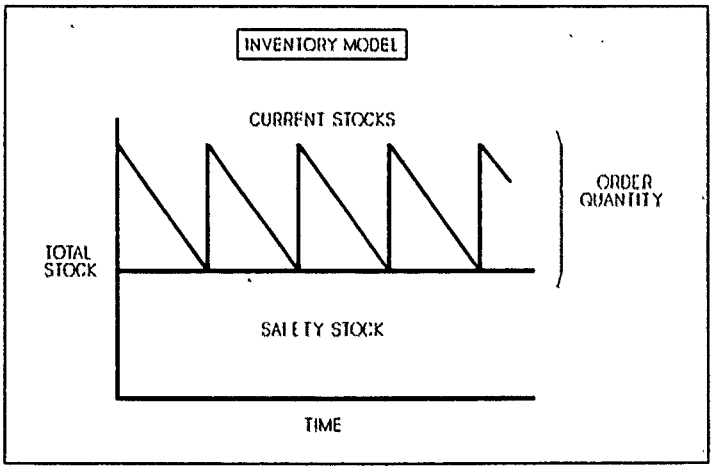

Figure 1. Fluctuations in Inventory over Time (1:201)

"The amount of inventory a company carries is determined by three basic variables: order quantity, lead time, and reliability of forecasts of materials usage" (1:200). Another inventory system which separates inventory into categories for further control is the ABC system.

ABC System. Ammer describes the ABC system of inventory control. This system is designed to group items by value: high-cost items in group A; medium-cost items in group B; and low-cost items in group C. The group C items are managed with a higher level of safety stock than either group A or B, as it is less expensive. As a result of the higher safety stock level, these items receive little attention from inventory clerks. More time is devoted to managing the Group A inventory, as it accounts for 70 percent of the total inventory value (1:221). A typical representation of the three categories is listed below in Table 1.

TABLE 1

ABC Inventory Categories (1:221)

Category	% of Items	% of Value
A	10	70
B	20	20
C	70	10

As depicted above, the A items account for only 10 percent of the total inventory, but 70 percent of the total value. The medium cost B items account for both 20 percent of the inventory items, and 20 percent of the value. The C items, which are the least expensive, comprise 70 percent of the total inventory, but only 10 percent of the value (1:221). "With ABC control, it is possible to risk fewer stockouts and reduce investment in inventories" (1:222). Ammer states that prevention of stockouts through the accumulation of safety stocks can be obtained fairly inexpensively for C items. If the same level of safety stocks were accumulated for A items, the total cost would be much greater for a lesser quantity of inventory, given that each item is more expensive. "The ABC system permits selective inventory control" (1:221).

The inventory control systems discussed above are all max-min systems, otherwise known as order-point systems. Ammer states that the benefits of these systems can be enormous in the correct applications. Max-min systems are most effective when both the lead time and the forecasted demand for the items can be predicted accurately (1:227). Not all inventory systems operate under such static conditions. Ammer concludes his discussion of max-min systems by describing three major weaknesses. According to a survey conducted by the National Industrial Conference Board, companies using inventory control systems reported

that max-min systems were not effective for the following reasons:

1) due to a lack of time, individual inventory item levels were not reviewed by management. As a result, the stock clerks were responsible for establishing stockage levels;

2) since management does not review each item's inventory level, years may pass before stockage levels and reorder points are adjusted to coincide with changes in demand; and

3) the posting of records can lead to a critical item not being ordered in a timely manner. The stock clerk responsible for posting the records may not be aware of the need for placing a new order until the last withdrawal of that item is recorded. The time delay in receiving the new order will be partially dependent upon the period of time required to conduct postings to the records (1:228).

Analytical Inventory Management Systems

There are a variety of analytical inventory control techniques which can be used for managing inventories. One such system is called the Economic Order Quantity (EOQ) system.

Economic Order Quantity System. Ammer states that "one of the most important goals in materials management is to strike the most economic balance between cost of possession

and cost of acquisition in determining order quantities" (1:239). These two values are essential to the use of the economic order quantity system of inventory management. Ammer defines the cost of possession as a combination of three costs: storage, obsolescence, and capital costs (1:239).

Storage cost is comprised of the cost for storing the inventories, such as warehousing and taxes, as well as the salaries of the personnel who work with the materials while in storage.

Obsolescence cost occurs when inventory for an item has accumulated. Either there is no demand for the item, or the demand is slower than expected, and the item spoils, shrinks, disappears or is not used. Ammer states that although obsolescence can not be predicted, it is possible to apportion a percentage of the total cost of possession as a buffer against losses from obsolescence. This portion of the cost of possession varies from organization to organization, "but few companies can hold it to less than 1 percent of the value of the inventory per year" (1:240).

Capital cost is the final area of cost of possession for inventories. This is the actual dollar value of the items being held in inventory.

One of the methods used to determine the efficient use of inventory capital is inventory turnover. Ammer describes this as the "ratio of sales to inventory" (1:240). There

are two ways in which a company can increase this ratio: by reducing inventories or by increasing sales while simultaneously maintaining inventory costs. Either situation will result in an increase in available capital (1:240).

Ammer describes another method for determining the cost of capital in inventory: opportunity cost. Under this method, it is assumed that the cost of capital is equal to what it would earn if it were invested in the most advantageous way (1:240). The range of cost determined from this method can vary widely. Even on a month to month basis, fluctuations in demand can drastically change opportunity costs.

The second value required for the use of the economic order quantity system is the cost of acquisition. Ammer describes two major costs which comprise the cost of acquisition: purchase and ordering.

Purchase cost is the money paid for the items of supply. This cost can fluctuate, depending on the quantity of the items ordered. If larger quantities can be purchased, the per item cost is usually lower than if smaller purchases were made.

Ordering costs are defined by Ammer as the other costs involved with the acquisition of supplies. These include transportation, receiving, expediting, and packaging (1:241).

Hospital Inventory Management Systems

Material relating to healthcare and hospital inventory management systems was very scarce. Only one reference source could be located which discussed inventory methods for this unique group of organizations. Dean Ammer, in his book, Purchasing and Materials Management for Health-Care Institutions, stated three reasons why it is necessary to maintain inventories: 1) Protection against uncertainty; 2) Substitute for other costs; and 3) Adjustment of usage to supply. As protection against uncertainty, inventories will serve as a buffer in the event of fluctuations in demand or changes in the supply system. In serving as a substitute for other costs, maintaining inventories reduces the costs involved with the purchasing and warehousing of supplies. As an example, an item bought in lots of 1, rather than lots of 100, would increase the administrative and processing requirements by 100. This would be extremely costly. Adjustment of usage to supply occurs when the quantity of supply required for use is less than the amount purchased, which results in a quantity maintained in inventory (2:118).

Ammer continues, "Inventory management is the science (and art) of weighing costs of carrying the stock against the losses that may accrue if the material is not available when needed" (2:118).

General Inventory Management Systems. For healthcare institutions, Ammer describes three types of inventory control systems: no control, order-point control, and periodic control. Some healthcare institutions use a combination of these systems.

No Control Inventory Management System. Ammer states that the no control system is often used by smaller healthcare organizations, wherein the cost of employing a controlled inventory system is more expensive than the results that would be achieved. An example of an organization which could effectively use this system is a small nursing home (2:119).

Order-Point Control Inventory Management System. Under the order-point control system, a specific level is selected as the reorder point. Whenever supplies fall to, or below, that level, a requisition for new supplies is processed. The time elapsed between order and receipt of supplies from the distributor is an important consideration for this method (2:119).

Periodic Control Inventory Management System. The third system which Ammer describes is the periodic control system. Under this method, the quantity ordered will vary, but the time between placing orders is constant; for example, once every 60 days (2:120).

Informally, both the periodic and order-point control systems are employed by hospitals. Periodic systems are informally used by hospitals when healthcare sales personnel visit the hospital at equal time intervals to replenish orders that are needed. On the other hand, the order-point system is often used informally with the two bin system, in which the working and reserve stock are located. Once the working stock is depleted, an order is placed and the reserve stock is used until the new order is received (2:120).

Ammer states that hospitals often have a cross between an order-point and a periodic system of inventory control. This is demonstrated by the fact that reserves of stock are maintained, either physically or through a computerized program. Yet, at the same time, a periodic ordering process is accomplished by sales personnel who visit as frequently as once per week to receive new orders for drugs and supplies (2:121).

Costs Involved with Inventories. For healthcare organizations, Ammer describes three major costs involved with inventories: cost of possession, usually represented as a percentage of total inventory value, cost of acquisition, and cost of stockout.

The four major components under cost of possession are purchase quantity, interest or opportunity cost storage cost, and obsolescence or shrinkage. "Purchase quantity is

usually the biggest determinant of inventory investment and, consequently, of average carrying cost" (2:122). Any organization desiring to minimize inventory and carrying costs will buy less quantity, more frequently. However, the supplies could be more expensive, as suppliers often provide a reduction in cost for larger quantities purchased.

Interest cost is defined by Ammer as the interest rate that the bank charges for an institution to borrow money. If inventory could be reduced, the total value of borrowed money would decrease also. "The institution that is not in debt would use a capital cost equal to what it could earn on the money if it were to invest it" (2:123).

Storage cost, the third component, is the amount of money required to warehouse and maintain the inventories. This cost is determined by dividing the total annual cost by the annual cost in inventory, and is expressed as a percentage (2:123).

The last component, obsolescence and shrinkage, occurs when an item of supply in inventory is no longer needed by the organization (obsolescence) or when the item is lost either through pilferage (shrinkage) or through neglect of staff personnel to charge a patient for an item.

The cost of acquisition in hospitals is comprised of two elements: first, the cost of transporting the supplies from the distributor to the hospital, and second, the cost of redistributing the supplies once the hospital has obtained

them (2:126). Included in the cost of acquisition is the cost of transportation, the wages and benefits of the personnel who move the materials, and the multitude of costs involved with the purchasing and receiving departments.

Ammer points out that the possibility of a stockout loss "varies inversely with the inventory investment" (2:128). To help ensure this stockout loss does not occur, safety stock is maintained to serve as a buffer when "lead-time usage is greater than expected" (2:129). There are two circumstances when this can occur: 1) demand is higher than expected during the lead-time, or 2) the quantity of time the supplier takes to ship an order is greater than anticipated (2:129).

Ammer states that the most precise system used to maintain inventory control for medical and surgical supplies and drugs is "an order-point system that operates periodically" (2:133). Under this system, many items are delivered on a regular, if not weekly, basis, and there is an order point set for each item used (2:133).

Aids to Inventory Control Methods

In order to gain insight into the aids available to control inventory management, a review of some of the current practices is provided. There are two terms which need clarification before proceeding. The first term is JIT, which is an acronym for Just-In-Time. This is a recent forecasting method used in the inventory and stockage of

supplies. The second term is electronic data interchange, which is a method of information transfer which uses communication lines. This part of the literature review will focus on three areas that are of importance in the total process of logistics management: Just-in-Time, bar-code labeling, and automation.

Just-In-Time. The first of the three areas which were reviewed is Just-In-Time, or JIT. Bowersox, Carter and Monczka conducted an overview of an educational program in Materials Logistics Management developed at the Graduate School of Business Administration at Michigan State University in 1980. The purpose of the program was to educate future professionals in the importance of materials management, with a particular emphasis on three areas: physical distribution, manufacturing, and purchasing (3:27). One subtopic under the area of manufacturing which was taught to the students is Just-In-Time. Bowersox states that another term for Just-In-Time is "Zero Inventory" (3:32). "The Japanese have become experts in inventory reduction" (3:32), which is an important aspect for manufacturing (3:32).

> The basic philosophy of JIT is that inventories only exist to cover problems. By reducing inventories, problems are exposed which then must be solved before inventories can be further reduced. (3:32)

Bowersox continues with a description of several methods which will assist in accomplishing the objectives of JIT. These methods are reduction of lot sizes, load leveling, and

quality control. If work schedules can be equally balanced with task accomplishment requirements, and personnel can be taught the importance of maintaining good quality in the performance of their tasks, then the most important aspect of JIT can be accomplished: attaining a reduction in inventory levels (3:32).

"Preventive maintenance is also important in JIT. Safety stock has traditionally been used to cover breakdowns" (3:32). Safety stock is in exact contradiction to the attempt to reduce stockage levels. If breakdowns could be prevented, or even reduced, then safety stocks would be diminished (3:32).

Millar describes another approach to Just-In-Time in his article, "Total Just-In-Time". Millar states that "JIT is a philosophy to which basic and well tried management models can be applied. It is a process, not a production control tool" (12:3).

Millar continues his discussion by touching upon the importance of the human resource in relation to implementing the JIT strategy. If the program is to work to the fullest extent possible, then the program's design must be centered around the personnel aspects. Ensuring that the strategy is user friendly provides a variety of benefits. Some of the benefits included in Millar's article are a reduction in inventory, perhaps up to 98%; improved quality; less waste and scrap; improved cash flow; a lower number of handling

operations; and an increase in teamwork, worker motivation and production (12:3-4).

Millar elevates the importance of the human element of JIT by stating that in order to receive the full benefits of the JIT strategy, development of the system must center around people, as it is people that make things happen, not strategies and plans (12:6).

Bar Code Labeling. The second of the three areas reviewed is bar code labeling. In "Bar Codes are Sales Tools," Cardais discusses the reasons why a firm must use bar code labeling in the performance of its logistics functions. He states that

> providing quick delivery, filling orders accurately, delivering on-time, and pricing competitively is the best way to keep existing customers and win new ones. Bar codes help you do just that. (4:95)

In the area of inventory control, Cardais describes the importance of taking accurate counts of supply levels to keep error rates and excess costs of duplicate inventories to a minimum. Bar code labeling is the solution to ensure accurate quantities are calculated and recorded (4:95). If costs can be decreased within the area of inventory management as a result of the accuracy involved in implementing bar code labeling, then a profit can be realized (4:95).

"Bar codes reduce the hard costs of inventory taking by cutting the labor costs of counting, data entry, management review, and verification" (4:95). Another benefit that

Cardais mentions is that if the process of inventory taking is more accurate and less time consuming, then a firm will not lose precious time being closed for the conduct of inventory processes (4:95).

Another important issue that Cardais discusses is the human element. It has been noted that employees who are scheduled to conduct physical inventories experience a decrease in morale. With the use of bar code labeling, the inventory process is much simplified, and this has demonstrated a positive impact on the morale of individuals conducting the inventory. Workers can conduct inventories alone. The need for two- or three-person count teams is removed, as is the need for extensive management review (4:95). In this manner, employees and managers spend less time with the inventory process.

Cardais discusses the method of determining error rates based on a percentage of the total number of invoices processed. One particular firm determined that its error rate, based on a figure of between one and five percent of total invoices, was calculated to equal $475,000 (4:95). The process of using bar code labeling produces approximately 99% accuracy (4:95). Through use of bar codes, the firm could reduce error spending by $470,250. "The key point is that bar codes reduce inventory taking costs and improve inventory record accuracy" (4:96).

Sadhwani and Tyson approached the topic of bar code labeling by analyzing the results of telephone interviews with bar code users. The respondents were a group of "83 preselected individuals who have designed, implemented, and used bar coding in their respective organizations" (14:45). The findings resulting from the survey showed the areas in which bar code labeling assisted the firms the most. The respondents revealed that bar code labeling was most often used in the areas of receiving, shipping and inventory tracking (14:45). The major reason for the use of bar code labeling in the areas of "product-movement" (14:45) was because the greatest need for improvement existed within that realm.

Sadhwani and Tyson further commented that large warehouse activities adopted the bar code labeling process. This sector was converted to ensure that supplies were stored in their appropriate locations, and that locations were recorded accurately (14:45).

Numerous benefits were realized as a result of implementing bar code labeling. Sadhwani and Tyson found that respondents of the interviews realized an increase in accuracy and in timeliness of information, greater inventory control, and a decrease in costs (14:46). One of the respondents determined that the increase in accuracy of inventories rose to a level of 99% (14:46).

Some of the interviewees mentioned disadvantages to bar code labeling, which included initial costs of equipment and a need for continuous support, education, and training (14:46). It was found by more than one respondent that "overall data collection costs increased after bar coding was implemented, mainly because additional application opportunities were identified, cost-justified, and implemented" (14:46).

Respondents to the telephone interview were asked why bar code labeling was implemented in their respective firms. Many of the interviewees stated that "a need for on-line systems was the driving force" (14:48). "Bar coding provides the most accurate, complete, and timely data that can be obtained from any source" (14:48).

Automation. The third area reviewed in aids to inventory control methods was that of automation. Robert Novack, in his article, "Logistics Control: An Approach to Quality," conducted a research effort to understand the importance of control in performing logistics activities, which for purposes of his study included production scheduling, inventory control, warehousing, and transportation (13:25). The method used to obtain the responses to this research was a mail survey. Novack received a membership roster from the Council of Logistics Management and randomly selected 300 high ranking logistics executives to whom the survey was mailed (13:25). One

question which was asked of the executives was, "Do logistics managers receive reports concerning the performance of order cycle and each of its components?" (13:28) Novack felt that in order for a logistics manager to have control, he must know if performance levels are being maintained (13:28). One of the methods for the manager to maintain control of the order cycle operations is through automation.

A specific area of order cycle operations that managers often have a lack of control over is transportation, which is frequently controlled by outside activities (13:30). "The shipper must rely, in part, on the carrier to supply performance reports on those transportation activities that will affect the order cycle" (13:30). As a result of automation, this necessary link for a logistics manager to maintain control over order cycle operations is being realized through the use of electronic data interchange (13:30). In this manner, the shipper is able to stay abreast of transportation movements until the destination is reached.

Another theory of automation in logistics management was presented by Haley and Krishnan in "It's Time for CALM: Computer-Aided Logistics Management". In this article, these authors discuss the importance of computer-based systems models to the total function of logistics management, including "facility planning, transportation,

inventory, handling, storage and communications" (9:24-25). With the use of simulation, it is possible to develop and test new strategies for operation and decision making before the system is actually implemented, (9:25) thereby offering a buffer on costs if the system proves not to be as useful as expected.

Automation of logistics management in a hospital setting offers a somewhat different approach, as discussed in Krupa and Hamlin's article, "Automation in Materiel Management: The Future is Now". This article presented an overview of one hospital's attempt at developing a fully integrated, automated, materiel management division (10:85). The process of automating the materiel management functions consisted of placing computers in four areas: the pharmacy, purchasing, warehouse and central supply (10:86).

The purchasing department's responsibilities involved all aspects of procurement. Krupa states that a "new application software using a computer networking concept" (10:86) was implemented. The implementation enabled buyers in the purchasing department to have on-line access to a central database of information, necessary in the performance of their jobs. As a result of this system, buyers had one hour per day free from purchasing responsibilities (10:86). Within the pharmacy, "an alternate method of controlling inventory was established" (10:87). A plan was developed with the supply distributor

to use a hand-held device for entering required orders. This information was transferred using telephone lines, and Krupa reports that as a result of this system, there was "an initial reduction in inventory of $20,000 and labor savings of approximately one hour per day in secretarial time" (10:87). Additionally, the distributor of supplies delivered on a daily basis, which allowed the pharmacy to maintain a minimal amount of supplies, thereby accomplishing Just-In-Time inventory management (10:87).

These two applications, which were implemented at Highland Park Hospital in the materials management division, demonstrate that increased efficiency can result from automating the logistics functions. "With the advent of expert systems and better use of information, upper-level management can now monitor and control lower levels of the organization more efficiently" (10:90).

Conclusion. "Logistics management is a total systems concept with a span of concern which ultimately encompasses all the movement and storage activities within the firm and its distribution channels" (5:52).

This literature review has revealed both basic, and analytical, inventory management methods which are commonly used by organizations. In addition, three aids to inventory control methods have been discussed. Although Just-In-Time and bar code labeling do not necessarily affect all areas of logistics management, the literature revealed that positive

results do occur with implementation of these methods. The examples of automation cited in the literature provide a complete, inclusive, system concept to improvements in many areas of logistics management, to include inventory management.

The next section discusses methods for measuring effectiveness with respect to hospital inventory management systems.

Inventory Effectiveness Factors

As discussed in Ammer's Purchasing and Materials Management for Health-Care Institutions, there are four targets which are necessary in order to achieve inventory effectiveness:

1. To have material on hand when needed.
2. To pay the lowest-possible prices for purchased materials of adequate quality.
3. To minimize inventory investment.
4. To operate efficiently. (2:203)

It is imperative that materials managers objectively assess the performance of the vendors they use. Vendors who unfailingly provide prompt deliveries of quality material should be praised for their performance, while those vendors who are tardy or provide low quality products should not be purchased from in the future (2:203).

Purchase price of supplies is an essential part of the vendor selection process. For the military hospitals, choosing the vendor with the lowest competitive bid is the rule rather than the exception. For the civilian hospitals,

it is necessary to calculate the aggregate performance. "The simplest (but not the best) barometer of purchasing-price performance is simply total purchases as a percentage of institutional revenues" (2:208). This is determined by taking the total cost of all purchases and dividing this figure by the total revenues for the hospital. The smaller the percentage, the better the aggregate performance (2:208).

Minimization of inventory investment is measured by inventory turnover rates. This figure is calculated by "dividing purchases of items carried in inventory by the actual value of the inventory" (2:212). The key to minimizing inventory is to find the appropriate turnover rate which reduces the dollar investment to an acceptable level. Ammer states that inventory turnover rates vary by groups of items. For example, medical-surgical supplies will have a higher turnover rate than drugs. For this reason, inventory turnover rates should be calculated individually for specific groups of items (2:212-213).

Hospitals must keep operating costs to a minimum in order to perform efficiently. For the materials manager, this is a complex task: it involves either a reduction in personnel, or an increase in productivity. According to Ammer, "at least 80% of the materials manager's operating costs are represented by the salaries and fringe benefits paid to his staff" (2:214). In some instances, the

purchase of automation equipment, such as electronic data processing equipment, will permit a reduction in personnel assigned to the materials management activity (2:215).

Specific Hospital Inventory Management Systems

Now that general inventory and hospital inventory management systems have been discussed, the following subsections provide the reader with an overview of the inventory management systems used at the three specific hospitals under investigation within this research.

Wright-Patterson Medical Center Inventory Management.

According to Air Force Manual 167-230, the inventory management system used at Wright-Patterson Medical Center is a portion of the Medical Logistics System (MEDLOG). "The MEDLOG system is primarily an inventory control and accounting system that accumulates and stores data relating to assets of a Medical Stock Record Account" (6:1-2). "The data base for MEDLOG consists of records stored on permanent disk and cartridge" (6:2-2). Although the system requires batch processing on a daily basis to update the data base, it is an on-line system which is functional on a stand-alone computer (6:2-1). Printed reports, depicting end of day, end of month, and end of fiscal year activity with the automated system, are produced as a result of the batch processing of the data base records and the transactions input by the user (6:2-3).

The system is configured as a distributed network of Datapoint hardware, which includes application processors, data and control, as well as line and character printers, and workstations (6:2-2).

Evans US Army Community Hospital Inventory Management. The inventory management system used at Evans US Army Community Hospital is SAILS, otherwise known as the Standard Army Intermediate Level Supply System. This is a computerized system that "includes all supply functions and some related stock fund/financial processing and reporting requirements" (7:13). This particular system has the capability of interfacing with the Standard Army Financial Inventory Accounting and Reporting System (STARFIARS) (7:13). "Medical and dental materiel...may be managed by SAILS Line Item Accounting (LIA) or by a separate automated or manual system" (7:13). Whichever system is chosen to manage medical and dental materiel, it should interface with the financial aspects of the SAILS system (7:13).

KMC Inventory Management. The inventory management system used at Kettering Medical Center is Walker Interactive Systems. According to a Walker Systems product brochure, this software application is primarily a financial package that is "designed for maximum flexibility and functionality" (15: no page). The system is both interactive and integrated, in that it provides interaction in a real-time mode to maintain currency of financial

status, and it is integrated in five ways: "a common data base; common systems tools; common transactions; common human interface; and common systems architecture" (15: no page).

To assist in inventory management, Walker Systems has developed the Interactive, Integrated Material Management System (II/MM) (15: no page), which is used at Kettering Medical Center. This software provides the following capabilities:

> calculates the Economic Order Quantity (EOQ) based on usage history; uses a lead time factor for reordering to help maintain sufficient supply based on user-specified 'loading' requirements; tracks material that has been allocated to special projects; and automatically reorders materials which have fallen below a pre-established reorder point. (16:12)

The system is an on-line, fully interactive, COBOL-based product which has been designed to "operate in most major computing environments" (16:12).

Summary

The preceding chapter provided an overview of some of the current inventory management systems used by hospitals and other organizations. Included in the discussion was a review of inventory effectiveness factors used in hospital inventory management systems. The methods of inventory management used at the three hospitals under investigation in this research were also discussed. The next chapter will discuss the methodology which will be used to find answers to the specific investigative questions posed in Chapter I.

III. Methodology

Introduction

This chapter discusses the methodology which will be used to provide answers to the investigative questions stated in Chapter I. This will be accomplished by developing a measurement instrument, in the form of a questionnaire, to be used in personal interviews. In addition, this chapter will portray the development and verification process of the measurement instrument, as well as a description of the population from which the responses will be obtained. Also included will be a comprehensive discussion of the analysis which will be used to examine the results obtained from the interviews. A total of two phases will comprise the research process.

Phase one involved a review of existing literature on inventory management practices. During this phase, a variety of inventory management methods were reviewed. The information used to complete this review was obtained through the Defense Technical Information Center (DTIC) and the on-line computer search for business related topics located at Wright State University, Dayton, Ohio. In addition, a limited amount of information was gained through using the Wright-Patterson Medical Center Library holdings.

Phase two will involve the development and administration of the research instrument. This instrument will be in the

form of a questionnaire used in personal interviews of managers and employees working with the inventory management systems at the selected hospitals. This researcher developed measurement questions to answer the investigative questions from Chapter I.

Measurement Instrument

As a result of the focus of this thesis, the researcher decided that a questionnaire, to be presented in personal interview format, would be the most appropriate method for collecting the information necessary to answer the investigative questions listed in Chapter I. The questionnaire should guard against interviewer bias. This research instrument will ensure that all personnel are asked exactly the same questions, thereby increasing the internal validity of the results. The questionnaire is located at Appendix A.

Development of the Instrument. The instrument which will be used to gather data for this thesis was developed by the researcher, in conjunction with subject matter experts in the field of logistics management. Each of the measurement questions in the questionnaire relates to information which is necessary to answer the investigative questions located in Chapter I. The form of response expected to be received is open-ended. As stated in Emory, open-ended questions are "appropriate when the objective is to discover opinions and degrees of knowledge" (3:217). The

first six questions within the questionnaire pertain to the background of the subjects. These are followed by seventeen questions relating to the inventory management system currently used within the respective hospital.

Verification of Instrument. The measurement instrument will be verified using review by both faculty and student personnel at the Air Force Institute of Technology. In addition, the instrument will be timed to ensure that the interviewees will not be kept from their work for an excessive amount of time. The length of time for the interview process which is judged by the researcher to be excessive is 45 minutes.

Population of Concern

The population of concern for this research will be the personnel working in the logistics management offices at Wright-Patterson Medical Center, Wright-Patterson Air Force Base, Dayton, Ohio; Evans US Army Community Hospital, Ft. Carson, Colorado; and Kettering Medical Center, Kettering, Ohio. The sample which will be selected from this population is comprised of individuals working with the respective inventory management systems at the specific hospitals. Stratified sampling will be used to determine the sample to whom the questions will be asked. The sample will be selected based upon a review of the respective hospital's logistics management organizational charts. The total

number of respondents from each hospital will be dependent upon the size of the organization, as well as the vertical hierarchy within the area of logistics.

Design for Analysis

This section states each investigative question and discusses the analysis which will be used to answer those questions, based upon the data obtained in Phase two of the research process.

Question 1. What inventory management systems are currently used in logistics divisions of DOD hospitals and in materiels management offices of civilian hospitals?

Question 2. How do inventory management systems measure both efficiency and effectiveness?

Question 3. How do the inventory management systems differ?

Question 4. If least cost is not maintained, where does management feel that improvements could be made?

Miles and Huberman present a variety of methods which can be used to analyze qualitative data. They state that qualitative data appears in the form of words, rather than numbers (11:21). The difficulty involved with the analysis of words is finding a method of representation which allows comparison and contrast in a simple form. "The most frequent form of display for qualitative data in the past has been narrative text"...which is "terribly cumbersome" (11:21). For this reason, selecting an alternate method of

data display will greatly enhance the qualitative analysis process.

In reviewing the qualitative data analysis methods presented by Miles and Huberman, the researcher will be using the conceptually clustered matrix as the technique for analyzing the responses to the measurement questions. Miles and Huberman state that it is difficult not only for the researcher, but also the reader, to understand "a separate analysis and section in a site report for each research question" (11:110). One method of overcoming this volume of information "is to cluster a few or even several research questions, so that meaning can be generated more easily" (11:110).

In using this approach, the researcher can group items based on observations or based on general ideas (11:110). Once this clustering of questions has been developed, the researcher will assign a scale, respective of the clustering, which will aid in analysis of the responses.

An example of the conceptually clustered matrix is displayed in Figure 2.

Research Questions / Informants	Motives (types)	Career relevance (none/ some)	Centrality (low/mod/ high)	Initial attitude (fav., neutr., unfav.)
Users				
U_1				
U_2, etc.				
Administrators				
A_1				
A_2, etc.				

Figure 2. Conceptually Clustered Matrix (11:111)

As depicted in the example above, the research questions have been clustered into the four conceptual groupings listed along the top of the matrix, or x-axis, reading from left to right: motives, career relevance, centrality, and initial attitude. In parentheses below each column heading is the scale by which the responses in that column will be rated. The ratings assigned will be used in the analysis of the responses. Along the side of the matrix, or y-axis, the informants are listed, reading from top to bottom: users (multiple users recorded as U_1, etc.) and administrators (multiple administrators recorded as A_1, etc.). Located within the interior blocks will be the actual responses of each informant, with respect to the heading at the top of the column.

This researcher will develop a conceptually clustered matrix with five column headings to analyze the responses to

the measurement questions listed in Appendix A. The conceptual grouping of the measurement questions will provide answers to the investigative questions of Chapter I. The columnar, or x-axis, headings will be listed as follows from left to right: system, level of satisfaction, size of hospital, level of inventory experience/knowledge, and efficiency/effectiveness of the system.

The y-axis will consist of the respondents, listed from top to bottom in descending order, by supervisory position within their particular activities. This will be based upon the stratified sample selected from the organizational charts provided by the respective logistics management sections of the hospitals.

The specific measurement questions from Appendix A which will be used as the basis for the grouping of columnar headings are as follows:

1) system: Question 11

2) level of satisfaction: Questions 12, 13, 14, 15, 17, 18, and 19

3) size of hospital: Questions 7, 8, and 10

4) level of inventory experience/knowledge: Questions 6, 9, and 16, and

5) efficiency/effectiveness of the system: Questions 15, 20, 21, 22, and 23.

The responses to the questionnaires obtained from the interviews will be placed within their respective blocks of the conceptually clustered matrix.

The specific scale which will be assigned to each of the columns will be determined after the responses to the questionnaires have been obtained. In this manner, the analysis of the responses will be more accurate and meaningful.

The researcher will be conducting a comparison of the three hospital's inventory management systems in two ways. The first method will be a comparison of each hospital's inventory management system. This will be accomplished by developing a conceptually clustered matrix of the responses by hospital. The second method which will be used is a comparison by supervisory position across the three activities studied. This will involve developing a conceptually clustered matrix, grouped by supervisory position in descending order along the y-axis, with multiple respondents per supervisory position.

Summary

This chapter has provided an explanation of the research process for this thesis. The two separate phases of research have been discussed in detail. The instrument development and verification have been described, along with the population of concern. Additionally, the design for analysis of the measurement questions has been discussed. Chapter IV provides a detailed discussion of the findings and analysis of the personal interviews. Chapter V will address the conclusions drawn and the recommendations proposed, based on the results of this research effort.

IV. Findings and Analysis

Introduction

This chapter discusses the research data collected during the interview process. Both the data collection process and the administration of the questionnaire will be presented. This will be followed by a listing of the responses obtained. The final portion of this chapter will be a variety of conceptually clustered matrix displays of the questionnaire results. These displays will demonstrate trends and differences within, and between, hospital inventory management systems, based upon the supervisory level of the individuals interviewed.

Data Collection

The measurement questions listed in Appendix A were mailed to the respective respondents in advance of the scheduled interview. This allowed the subjects sufficient time to gather their thoughts and develop responses prior to the researcher meeting with the interviewees. In this manner, the amount of time required for the interviews was minimized. Then, telephonic contact was made with the respective individuals to arrange for a date and time for the personal interview. In order to obtain a precise response, the researcher tape-recorded as many of the

interview sessions as possible, subject to the respondent's approval.

Questionnaire Validation

Due to the lack of medical logistics personnel available at the Air Force Institute of Technology through which a validation of the questionnaire could be conducted, the researcher performed this validation with the first group of interviewees at Wright-Patterson Medical Center. The validation was accomplished as follows. The existing questionnaire from Appendix A was used to perform the interviews for all the subjects at Wright-Patterson Medical Center. After conducting the interview, each interviewee was asked if he thought any additional questions would be necessary, in conducting this particular research, to make the questionnaire a better instrument. None of the persons interviewed felt that additional questions were needed; therefore, the researcher made no changes to the original questionnaire which had been developed.

Questionnaire Administration

The first hospital from which subjects were interviewed was Wright-Patterson Medical Center, Wright-Patterson Air Force Base, Ohio. All of the interviews took place within the respective subject's work areas, and these interviews were conducted from 19 April 1991 through 7 May 1991. A

total of six employees from Wright-Patterson Medical Center were selected and interviewed.

The second hospital chosen to conduct the interviews was Kettering Medical Center, Kettering, Ohio. Again, all of the interviews took place at the respective subject's work areas. The interviews for employees at Kettering Medical Center were conducted from 10 May 1991 through 22 May 1991. There were five interviewees selected from Kettering Medical Center.

The final hospital from which employees were interviewed was Evans US Army Community Hospital, Ft. Carson, Colorado. With this particular hospital, the interviews were conducted telephonically, without the use of the tape recorder. The researcher telephoned the respective interviewees and arranged for a date and time to conduct the telephonic interview. A total of five employees were selected and interviewed from 5 June 1991 through 11 June 1991.

Findings

A summarized listing of the answers obtained from conducting the interviews is located at Appendices B, C, and D, representing the responses from interviewees at Wright-Patterson Medical Center, Kettering Medical Center, and Evans US Army Community Hospital, respectively.

Analysis

Demographics. To provide information on the position and supervisory level of the individuals interviewed, the following table was developed to show the total number of individuals interviewed, with a listing of job title, number of employees supervised, number of years in the current position, and other positions within the hospital in which the individual has served.

TABLE 2

Demographics of Respondents

Job Title	Number Interviewed	# of Employees Supervised	# of Years	Other Positions
Administrative Director, Material Management	1	170	4	
Medical Logistics, Associate Administrator	1	3	2	
Chief, Logistics Division	1	140	4	
Manager, Inventory Control	1	90	1 yr, 5 mos.	
Director, Materiel and Acquisition	1	62	2 yrs, 7 mos.	
Non-Commissioned Officer-In-Charge, Logistics Division	1	0	4	
Stores Coordinator, Inventory Control Department	1	10	3	Supply Distribution

TABLE 2 (Continued)

Demographics of Respondents

Job Title	Number Interviewed	# of Employees Supervised	# of Years	Other Positions
Superintendent, Medical Materiel	1	43	2 yrs, 2 mos.	
Inventory Control Coordinator	1	27	6	Assistant, Supply Distribution; Stock Clerk; Central Stores
Superintendent, Materiel and Acquisition	1	29	8 mos.	Non-Commissioned Officer-In-Charge, Stock Records
Chief, Materiel Branch	1	25	2	
Logistics Systems Analyst	1	0	2	
Supervisor, Supply Technician	1	13	4	Supply Technician
Cart Exchange Coordinator	1	20	1 yr, 6 mos.	Nurse's Aid; Central Services Assistant Technician
Chief, Central Processing and Distribution	1	12	6	Non-Commissioned Officer-In-Charge, Inventory Management
Non-Commissioned Officer-In-Charge, Requisition Management	1	2	10 mos.	Central Processing and Distribution

Conceptually Clustered Matrices. The following section is a display of the matrices for each of the three hospitals interviewed. In addition, the last matrix is provided to display the variations between the hospitals, based on position. An analysis of each hospital is included, directly following the matrix. Table 3 depicts the conceptually clustered matrix for Wright-Patterson Medical

Center, Table 4 is a display of the conceptually clustered matrix for Kettering Medical Center, Table 5 portrays the conceptually clustered matrix for Evans US Army Community Hospital, and Table 6 delineates the conceptually clustered matrix across hospitals by position.

The scale selected to analyze each of the columns in the tables is as follows: type for system; low, moderate or high for level of satisfaction; small, medium, or large for s of hospital; low, moderate or high for level of inventory experience/knowledge; and low, moderate or high for efficiency/effectiveness of system.

The criteria used to determine the scales is as follows. For level of satisfaction, low indicated an individual that did not like the inventory management system, moderate indicated an individual that liked the system, but felt major changes were needed as improvements, and high indicated an individual that liked the system as it was or felt minor changes were needed. For size of hospital, this scale was based on the number of hospital beds available. Small indicated a range of 0-100, medium indicated a range of 101-300, and large indicated bed capacity greater than 300. For level of inventory experience/knowledge, low indicated no other inventory system experience except the current system, moderate indicated experience with another inventory system or knowledge of other inventory systems,

and high indicated both experience with other inventory systems and knowledge of other inventory systems.

TABLE 3
CONCEPTUALLY CLUSTERED MATRIX
(Wright-Patterson Medical Center)

Research Questions / Interviewees	System (type)	Level of Satisfaction (low/mod/high)	Size of Hospital (sm/med/lg)	Level of Inventory Experience/Knowledge (low/mod/high)	Efficiency/Effectiveness of System (low/mod/high)
Senior Management I_1	Automated Air Force inventory management system which uses EOQ to determine safety levels and order quantities.	High. Current system is quite good, especially w/military constraints. Not as flexible for doing data base queries.	Medium. 245 operating beds. $21 million annual inventory. 11-12 turns per year.	High. 3 yrs experience in another AF facility. 8 months in a comparative study of AF and civilian hospital inv mgt systems. Familiar w/JIT and stockless.	High. Measured by fill rate, turnover rate, and percentage of excess. 95% fill rate is acceptable, which is typically maintained. Customer is involved.
Middle Management I_1	Automated Air Force system which uses EOQ and a modified ABC analysis to determine safety levels and order quantities.	High. Current system is good, especially if it can be fine-tuned and modified. Cannot interface with the system much.	Medium. 300 beds. $1.8 million on-hand. 11-12 turns per year.	Med. No other military inv mgt experience. Assistant store mgt in retail before military. Not familiar w/another inventory mgt system.	High. Measured by turnover rate, fill rate, excess quantitites, destructions. 95% fill rate is acceptable. Customer is involved.
I_2	Medical Material Mgt System. Includes inv control & requisitioning. Stockage based on demand history.	High. Basic system is good. Some limitations need improvements, such as number of storage locations.	Large. About 325 beds. $1.5 million inventory on hand. Inventory turns every 1.5 - 2 months.	Mod. In this field for 15 yrs. Managed grocery store before mil. Not qualified to discuss other inv mgt systems.	High. Measured by fill rate and customer satisfaction. 95% fill rate is acceptable. Customer is involved.
I_3	EOQ.	Mod. System works for way system is designed. It would be better if set up on contract like civilian hospitals.	Large. Expandable to 320 beds. $1 million on hand. Inventory turns every 2 - 2.5 months.	Mod. Worked with medical equipment mgt. Not worked with another inventory mgt system.	Mod. Measured by fill rate, stock on hand & % of excess. 95% fill rate is acceptable. Customer is involved.
Direct Supervisor of System Users I_1	Tri-service, tri-logistics computer system. Based on consumption, it sets levels and reorder points.	Low. Previous sys had better reporting & ad hoc query capability. Current system needs better rpt capabilities for ad hoc queries.	Medium. About 250 beds. $150,000 for CP&D. Inventory turns about 11 times per year.	Mod. Worked as NCOIC, Med Logistics & was responsible for inv mgt. Not familiar with any other inventory management systems.	Low. CP&D has no way to measure efficiency or effectiveness of the system. Customer is involved.
I_2	I don't feel that I know what type of system it is.	High. Have basis for any changes in our own sys. A matter of adjustments. Always room for improvement. A research section would be good.	Large. Expandable to 320 beds. About $20 million inventory. Don't know our inventory turnover rate.	Mod. Worked in base supply for 6 years with inv management and special assets management systems.	High. Measured by fill rate and quantity of inventory on hand. 95% fill rate is acceptable. Customer is involved.

Wright-Patterson Medical Center. Based upon the responses of the individuals interviewed, the type of inventory management system used at Wright-Patterson Medical Center is an automated Air Force inventory management system which uses Economic Order Quantity as the foundation for determining safety levels of stock and order quantities. One of the individuals interviewed discussed the Central Processing and Distribution system, which is a tri-service, tri-logistics computer system used for the distribution of supplies to the respective clinics and wards within the hospital. This system is one level below the inventory management system that the other five respondents discussed. Four out of six respondents indicated a high level of satisfaction with the system. These interviewees discussed a need for minor changes to the current system, but otherwise, were quite satisfied. Three of the respondents indicated that the hospital was medium-sized, and three indicated the hospital to be large. The responses for the total dollar inventory for the hospital ranged from $1 million on hand to $21 million for an annual inventory. The responses to the inventory turnover rate for the hospital ranged from 4.8 to 12 turns per year. Three of the six respondents stated that the inventory turnover rate was between 11 and 12 turns per year. Regarding level of inventory experience/knowledge, five of six respondents indicated a moderate level of experience/knowledge. One

respondent had a high level. For the efficiency/ effectiveness of the system, four of the six respondents indicated the system to be operating at a high level of efficiency/effectiveness. Five of six respondents stated that fill rate was used as a measure of system efficiency/ effectiveness, with a quantitative measurement of 95% as an acceptable level of operation. In addition, two interviewees stated that turnover rate was also an indication of the efficiency/effectiveness of the system. Two interviewees discussed inventory, or stock on hand, as a measurement tool; three interviewees indicated percentage of excess; one interviewee discussed the quantity of destructions; and one interviewee mentioned customer satisfaction as a measure of the efficiency/effectiveness of the inventory management system. All six interviewees indicated that the customer is involved in the measurement of the acceptable level for efficiency/effectiveness.

TABLE 4
CONCEPTUALLY CLUSTERED MATRIX
(Kettering Medical Center)

Research Questions / Interviewees	System (type)	Level of Satisfaction (low/mod/high)	Size of Hospital (sm/med/lg)	Level of Inventory Experience/Knowledge (low/mod/high)	Efficiency/Effectiveness of System (low/mod/high)
Senior Management I_1	System called Walker to monitor inventory. Also have AIM for exchange cart. Maintains inventory levels and recommends orders based on EOQ.	Mod. No system cannot be improved or upgraded. There are simpler methods of accessing and inputting information.	Large. 634 beds. Official inventory is about $800,000. Inventory turnover is 11.5 turns per year.	High. Worked as a consultant for a material mgt service for 3 yrs & as a supply distribution & inv control mgr for 5 yrs. Familiar with dozens of other systems.	High. Fill rate and timeliness of delivery of orders. Get the item there when they need it. Customer is involved.
Middle Management I_1	A total pkg system w/ finance called Walker Interactive Systems. Primarily a financial package that has materials mgt too.	Low. Not as good as it could be. An o.k. inventory system, but does not adapt well to the hospital environment.	Large. 634 beds. Maintain about $800,000 of inventory. About 11 turns per year.	High. Director, Material Mgt for a hospital for 4.5 yrs, and worked at another hospital in purchasing for 5 yrs. Familiar w/several inv management systems.	Mod. Measure stockouts, inv turns based on on-hand value & chargeouts. If primary product is not available, secondary product should be. Customer is involved.
Direct Supervisor of System Users I_1	Walker System. It is a computer linking purchasing, inventory control and accounts payable. Through EOQ can set stockage levels manually.	Mod. Know there are systems available that are better. Current system is more financial than inventory related.	Large. 630 beds. $820,000 inv, not including specialized inventory. Average about 11 turns per year.	Mod. Worked at K-Mart with a manual inventory system. Not familiar with other inventory management systems.	High. Make sure other departments have supplies when they need them. Working at acceptable level now. Customer is involved.
I_2	Uses EOQ philosophy for prompting of orders for replenishment of supplies.	High. Current system is an inv pkg that has been altered for health care needs. System needs quicker response time to fluctuate up and down with spikes.	Large. 630 beds. About $950,000 inventory value. About 11 turns per year.	Mod. Not worked w/any computerized systems. Was a mgr with Singer Sewing Machines, but the tracking was manual. Not familiar with any specific inv systems.	High. Measure stockouts and fill rate. Ensure we are never out of needed supplies. Customer is involved.
I_3	It is called Walker Material Management System. Carts use AIM, which is all computerized.	Mod. Need to continually upgrade our system. Built in limitations. Need automated system to track both stocked & non-stocked items with multiple locations.	Large. 634 beds. $800,000 inventory. About 11 turns per year.	Mod. Kept own inventory of products with Mary Kay Cosmetics. Not familiar with any other inventory management systems.	High. Measure stockouts. Strive for no stockouts. Customer is involved.

Kettering Medical Center. The inventory management system used at Kettering Medical Center is called Walker Interactive Systems. This automated system is primarily a financial package with materials management capabilities. All five of the respondents were familiar with the system, and three of five respondents stated that Economic Order Quantity was the foundation for determining stockage and reorder levels. Three of the five respondents indicated a moderate level of satisfaction with the system. One respondent indicated a low level of satisfaction, and one indicated a high level of satisfaction. A variety of necessary changes to the current system were mentioned. One interviewee stated that the system did not adapt well to the hospital environment; one respondent stated that the system was primarily a financial system, rather than an inventory system; one respondent indicated that the system should have a quicker response time to fluctuations; and one respondent indicated a need to track both stocked and non-stocked lines of supply. Regarding size of the hospital, all five respondents indicated the hospital to be large. Three of five respondents stated that the hospital had 634 beds, and two respondents stated 630 beds. The total dollar inventory for the hospital ranged from $800,000 to $920,000. Three of the five respondents indicated the total dollar inventory to be $800,000; one respondent indicated $820,000; and one respondent indicated $920,000. The range of responses for

the inventory turnover rate was from 11 per year to 11.5 per year. With respect to the level of inventory experience/ knowledge, three of five respondents indicated a moderate level, and two of five indicated a high level. All the respondents had worked with inventory management systems, either manual or automated, in previous employment. Four of the five respondents indicated that the inventory management system operated at a high level of efficiency/effectiveness, while one respondent indicated a moderate level. Three respondents indicated stockouts as a measurement tool; two respondents indicated fill rate; two respondents stated timeliness of delivery of orders; and one respondent stated inventory turns based on on-hand value and quantity of chargeouts. Four of the five respondents indicated that the measurement of the acceptable level of efficiency/ effectiveness is ensuring that supplies are available when needed. One respondent indicated that a secondary product should be available if the primary product is not. All five respondents indicated that the customer is involved in the measurement of the acceptable level for efficiency/ effectiveness.

TABLE 5
CONCEPTUALLY CLUSTERED MATRIX
(Evans US Army Community Hospital)

Research Questions / Interviewees	System (Type)	Level of Satisfaction (low/mod/high)	Size of Hospital (sm/med/lg)	Level of Inventory Experience/Knowledge (low/mod/high)	Efficiency/Effectiveness of System (low/mod/high)
Senior Management I_1	SAILS, the Standard Army Intermediate Level Supply System. EOQ based system.	Low. *SAILS is not a* good system. Has a high error rate.	Med. 195 beds. $4 million inventory, including IMRS. Don't know exact figure for inventory turns.	High. Worked as Medical Supply Officer for an automated and a manual account. In Europe, responsible for the automated inv systems for the command. Familiar with TAMMIS.	Mod. Measure zero balance rate and demand satisfaction (DS) and accommodation (DA). Customer is involved.
I_2	SAILS. Computes and generates everything that is needed.	High. SAILS does the job quite well.	Med. 195 beds. About $4 million inventory. Turnover rate is every 90 days.	Mod. All previous work has been with SAILS. Have worked with manual system also. Familiar with AMEDDPAS.	High. Measure DS and DA. Acceptable level is 90%-100% for DS and 65%-85% for DA. Customer is not involved.
Middle Management I_1	SAILS. It is automated but non-specific. It handles all classes of supplies.	Low. *SAILS is not* responsive enough. Not an on-line system. Often cycles don't run Too many people's hands in it.	Med. 195 beds. About $4.5 million inv. Carry 90 days of supply, & that turns over fairly equally.	Mod. Worked with a 400 line manual inventory system. Familiar with MEDSTOCK.	Mod. Measure DA, DS and zero balance rates. Acceptable level is 65%-85% for DA, 90%-100% for DS and 0-8% for zero balance rate. Customer is involved indirectly.
I_2	SAILS. A standard Army system which uses batch processing. Has all material categories, not just medical.	Mod. SAILS needs to be *more on-line and more* responsive.	I don't know bed capacity or the inventory turnover rate. About $4.5 million inventory.	High. Worked with MEDSTOCK, CP&D, AMEDDPAS, and SAILS.	Med. Measure DA, DS, and zero balance rate. Acceptable level is 70-85% for DA and 5-8% for zero balance. Customer is involved somewhat.
Direct Supervisor of System Users I_1	SAILS.	Low. Poor system for management of excess stocks. The steps necessary to input or complete a job are very timely.	Med. 195 beds. $4.5 million inventory. Inventory turnover rate is every 90 days.	Mod. Only worked with SAILS at this hospital. Familiar with MEDSTOCK and TAMMIS.	Mod. Measure DS, DA and zero balance rates. Acceptable level is 90-100% for DS, 65-85% for DA, and less than 8% for zero balance. Customer is not involved.

Evans US Army Community Hospital. The inventory management system used at Evans US Army Community Hospital is SAILS, the Standard Army Intermediate Level Supply System. This system is a standard army automated inventory management system which uses batch processing and controls all material categories, not just medical. The basis for this inventory management system is EOQ. All five respondents were familiar with the SAILS system. Three of five respondents indicated a low level of satisfaction with the system. These individuals stated that the system had a high error rate, was not responsive enough, and that the system was not on-line. In addition, the management of excess stocks was difficult with SAILS, and the steps required to input or complete jobs was time consuming. One respondent indicated a moderate level of satisfaction, and one respondent indicated a high level of satisfaction. The respondent indicating a high level of satisfaction does not work directly with the SAILS system. In reference to the size of the hospital, four of the five respondents indicated the hospital to be medium sized, with 195 beds, and one respondent did not know the bed capacity. The total dollar inventory for the hospital ranged from $4 million to $4.5 million, with two respondents indicating $4 million, and three respondents indicating $4.5 million. Three of five respondents indicated that the inventory turnover rate for the hospital was every 90 days, and two respondents did not

know the inventory turnover rate. With respect to the level of inventory experience/knowledge, three of five respondents indicated a moderate level, and two of five indicated a high level. Four of the five respondents indicated that the level of efficiency/effectiveness of the system was moderate, and one respondent indicated that the level was high. Four of the five respondents stated that the measurement tools used are zero balance rates, demand accommodation, and demand satisfaction. One respondent indicated that demand accommodation and demand satisfaction are measured. Three of five respondents indicated that the measurement of the acceptable level is 90%-100% for demand satisfaction, and 65%-85% for demand accommodation. One respondent indicated that the acceptable level for demand accommodation is 70%-85%. Two respondents indicated that the acceptable level for zero balance rates is 0%-8%, while one respondent stated that it is 5%-8%. One respondent did not address the acceptable levels for demand accommodation, demand satisfaction, and zero balance rates. Two of the five respondents indicated that the customer is not involved in the measurement of the acceptable level for efficiency/effectiveness; one respondent stated that the customer is involved; one respondent indicated that the customer is involved somewhat; and one respondent stated that the customer is involved indirectly.

TABLE 6
CONCEPTUALLY CLUSTERED MATRIX
(Across Hospitals by Position)

Research Questions / Interviewees	System (type)	Level of Satisfaction (low/mod/high)	Size of Hospital (sm/mod/lg)	Level of Inventory Experience/Knowledge (low/mod/high)	Efficiency/Effectiveness of System (low/mod/high)
Senior Management I_{SM}	Automated Air Force inventory management system which uses EOQ to determine safety levels and order quantities.	High. Current system is quite good, especially w/military constraints. Not as flexible for doing data base queries.	Medium. 245 operating beds. $21 million annual inventory. 11-12 turns per year.	High. 3 yrs experience in another AF facility. 8 months in a comparative study of AF and civilian hospital inv mgt systems. Familiar w/JIT and stockless.	High. Measured by fill rate, turnover rate, and percentage of excess. 95% fill rate is acceptable, which is typically maintained. Customer is involved.
I_{LMC}	System caled Walker to monitor inventory. Also have AIM for exchange cart. Maintains inventory levels and recommends orders based on EOQ.	Med. No system cannot be improved or upgraded. There are simpler methods of accessing and inputting information.	Large. 634 beds. Official inventory is about $800,000. Inventory turnover is 11.5 turns per year.	High. Worked as a consultant for a material mgt service for 3 yrs & as a supply distribution & inv control mgr for 5 yrs. Familiar with dozens of other systems.	High. Fill rate and timeliness of delivery of orders. Get the item there when they need it. Customer is involved.
I_{SAILS}	SAILS, the Standard Army Intermediate Level Supply System. EOQ based system.	Low. SAILS is not a good system. Has a high error rate.	Med. 195 beds. $4 million inventory, including PWRS. Don't know exact figure for inventory turns.	High. Med Sup Officer for automated & manual accts. In Europe, responsible for automated inv systems for the cmd. Familiar with TAMMIS.	Med. Measure zero balance rate and demand satisfaction (DS) and accommodation (DA). Customer is involved.

TABLE 6 (CONT'D)
CONCEPTUALLY CLUSTERED MATRIX
(Across Hospitals by Position)

Research Questions / Interviewees	System (type)	Level of Satisfaction (low/mod/high)	Size of Hospital (sm/med/lg)	Level of Inventory Experience/Knowledge (low/mod/high)	Efficiency/Effectiveness of System (low/mod/high)
Middle Management I_{MMC}	Automated Air Force system which uses EOQ and a modified ABC analysis to determine safety levels and order quantities.	High. Current system is good, especially if it can be fine-tuned and modified. Cannot interface with the system much.	Medium. 300 beds. $1.8 million on-hand. 11-12 turns per year.	Mod. No other military inv mgt experience. Assistant store mgt in retail before military. Not familiar w/another inventory mgt system.	High. Measured by turn-over rate, fill rate. excess quantitites, destructions. 95% fill rate is acceptable. Customer is involved.
I_{HMC}	A total pkg system w/ finance called Walker Interactive Systems. Primarily a financial package that has materials mgt too.	Low. Not as good as it could be. An o.k. inventory system, but does not adapt well to the hospital environment.	Large. 634 beds. Maintain about $800,000 of inventory. About 11 turns per year.	High. Director, Material Mgt for a hospital for 4.5 yrs, and worked at another hospital in purchasing for 5 yrs. Familiar w/several inv management systems.	Mod. Measure stockouts, inv turns based on on-hand value & chargeouts. If primary product is not available, secondary product should be. Customer is involved
$I_{[illegible]}$	SAILS. It is automated but non-specific. It handles all classes of supplies.	Low. SAILS is not responsive enough. Not an on-line system. Often cycles don't run Too many people's hands in it.	Med. 195 beds. About $4.5 million inv. Carry 90 days of supply, & that turns over fairly equally.	Mod. Worked with a 400 line manual inventory system. Familiar with MEDSTOCK.	Mod. Measure DA, DS and zero balance rates. Acceptable level is 65%-85% for DA, 90%-100% for DS and 0-8% for zero balance rate. Customer is involved indirectly.

TABLE 6 (CONT'D)
CONCEPTUALLY CLUSTERED MATRIX
(Across Hospitals by Position)

Research Questions / Interviewees	System (type)	Level of Satisfaction (low/mod/high)	Size of Hospital (sm/med/lg)	Level of Inventory Experience/Knowledge (low/mod/high)	Efficiency/Effectiveness of System (low/mod/high)
Direct Supervisor of System Users I_{SPVC}	I don't feel that I know what type of system it is.	High. Have basis for any changes in our own sys. A matter of adjustments. Always room for improvement. A research section would be good.	Large. Expandable to 320 beds. About $ million inventory. Don't know our inventory turnover rate.	Mod. Worked in base supply for 6 years with inv management and special assets management systems.	High. Measured by fill rate and quantity of inventory on hand. 95% fill rate is acceptable. Customer is involved.
I_{DSC}	Uses EOQ philosophy for prompting of orders for replenishment of supplies.	High. Current system is an inv pkg that has been altered for health care needs. System needs quicker response time to fluctuate up and down with spikes.	Large. 630 beds. About $950,000 inv value. About 11 turns per year.	Mod. Not worked w/any computerized systems. Was a mgr with Singer Sewing Machines, but the tracking was manual. Not familiar with any specific inv systems.	High. Measure stockouts and fill rate. Ensure we are neve rout of needed supplies. Customer is involved.
I_{EVMS}	SAILS.	Low. Poor system for management of excess stocks. The steps necessary to input or complete a job are very timely.	Med. 195 beds. $4.5 million inventory. Inventory turnover rate is every 90 days.	Mod. Only worked with SAILS at this hospital. Familiar with MEDSTOCK and TAMMIS.	Mod. Measure DS, DA and zero balance rates. Acceptable level is 90-100% for DS, 65-85% for DA, and less than 8% for zero balance. Customer is not involved.

Conceptually Clustered Matrix Across Hospitals by Position. This matrix was designed by selecting one respondent from each hospital who worked in the three levels of management indicated on the matrix: senior management, middle management, and direct supervisor of system users. The basis for this selection was the researcher's understanding of the similari'y between the positions of the individuals at their respective organizations.

Within senior management, the respondent at Wright-Patterson Medical Center (WPMC) indicated the highest level of satisfaction with the system; the respondent at Kettering Medical Center (KMC) indicated a moderate level of satisfaction; and the respondent at Evans US Army Community Hospital (Evans) indicated a low level of satisfaction. With reference to the size of hospital, WPMC and Evans were indicated as medium-sized, and KMC was indicated as large. WPMC had the highest value of inventory at $21 million. Evans maintained the next largest inventory, with $4 million, and KMC had the lowest amount of inventory, valued at $800,000. The level of inventory experience/knowledge was high for all three senior management respondents. The level of efficiency/effectiveness of the system was indicated by the respondents at WPMC and KMC to be high, whereas at Evans, the respondent indicated a moderate level.

Within middle management, the level of satisfaction with the system was indicated as high by the respondent at WPMC,

and low by the respondents at KMC and Evans. The size of the hospital was indicated as medium by the respondents at WPMC and Evans. The respondent at KMC indicated the size as large. The respondent at KMC had the highest level of inventory experience/knowledge, and the respondents at WPMC and Evans indicated a moderate level. The respondent at WPMC indicated the level of efficiency/effectiveness of the system as high, whereas the respondents at KMC and Evans indicated a moderate level.

Within the management level of direct supervisor of system users, the respondents at WPMC and KMC indicated the level of satisfaction with the system as high. The respondent at Evans indicated a low level of satisfaction. The size of the hospital was indicated as large by the respondents at WPMC and KMC, and medium by the respondent at Evans. The level of inventory experience/knowledge was indicated by all the respondents as moderate. With respect to level of efficiency/effectiveness of the system, the respondents at WPMC and KMC indicated a high level, whereas the respondent at Evans indicated a moderate level.

Across the three levels of management within a hospital the three respondents at WPMC each indicated a high level of satisfaction with the system and a high level of efficiency/effectiveness of the system. This parallels the similarity of responses by the interviewees at Evans. Each of the three respondents indicated a low level of

satisfaction with the system, and a moderate level of efficiency/effectiveness of the system.

Conclusions

This chapter has provided the reader with a discussion of the data collection and validation procedures, the steps involved in the administration of the questionnaire, and a summarized listing of the findings obtained from each of the interviewees. In addition, an analysis of the responses within each hospital, and across the three hospitals, by position, was provided through the development of the conceptually clustered matrices.

Chapter V will discuss the conclusions drawn, and recommendations made, based on the results and analysis obtained from this research.

V. Conclusions and Recommendations

Introduction

This chapter discusses the conclusions that have been derived, based on the results of this research process. Conclusions, grouped by hospital, have been drawn for matrix column headings in which the majority of respondents' answers were comparable. In addition, this chapter provides answers to the specific research and investigative questions listed in Chapter I, as well as recommendations for further research in the area of hospital inventory management systems. The chapter concludes with a summary of the benefits of this research.

Conclusions

Wright-Patterson Medical Center. The conclusions resulting from the analysis of the inventory management system at WPMC are the following:

1) the inventory management system uses EOQ as the basis for stockage levels and reorder quantities;

2) there exists a high level of satisfaction with the current system;

3) the majority of the interviewees had a moderate level of experience/knowledge of inventory management; and

4) the level of efficiency/effectiveness of the system is high.

Kettering Medical Center. The conclusions from the analysis of the inventory management system at KMC are as follows:

1) this inventory management system also uses EOQ as the basis for stockage levels and reorder quantities;

2) there is a moderate level of satisfaction with the inventory management system;

3) there exists a high level of experience/knowledge within both the senior management, as well as the middle management levels;

4) it is a large-sized hospital; and

5) the level of efficiency/effectiveness of the system is high.

Evans US Army Community Hospital.

The conclusions of the analysis of the hospital inventory management system at Evans are as follows:

1) the inventory management system uses EOQ as the basis for stockage levels and reorder quantities;

2) there is a low level of satisfaction with the inventory management system;

3) it is a medium-sized hospital;

4) the majority of interviewees had a moderate level of inventory experience/knowledge; and

5) the level of efficiency/effectiveness of the inventory management system is moderate.

Of the three systems investigated during this research, the system used at WPMC was the most efficient and effective inventory management system studied. Although the respondents from that organization stated that modifications

to the system would be useful, the system performed its functions in a very satisfactory manner.

Investigative Questions.

Question 1. What inventory management systems are currently used in logistics divisions of DOD hospitals and in materiel management offices of civilian hospitals?

The systems used by the three hospitals under investigation are automated. WPMC, KMC and Evans each have EOQ as the basis of their systems.

Question 2. How do inventory management systems measure both efficiency and effectiveness?

The inventory management systems at WPMC and Evans have definitive quantitative measures to determine efficiency and effectiveness. For WPMC, these factors are measured by a 95% fill rate. At Evans, demand satisfaction, demand accommodation, and zero balance rates are the factors used to measure efficiency and effectiveness. For demand accommodation, the range is 65%-85%; for demand satisfaction, the range is 90%-100%, and for zero balance rate, the range is 0-8%. KMC did not have a quantitative value to measure efficiency and effectiveness. Ensuring that supplies are available when needed is the measure of efficiency/effectiveness.

Question 3. How do inventory management systems differ?

As stated previously, all three inventory management systems researched are automated. Evans differs the most from the other systems in that it is a standard system covering all classes of supplies, not just medical. The system at WPMC is an Air Force system which has been used for medical inventory management for many years. KMC uses a financial-based system which also has materials management capabilities.

Question 4. If least cost is not maintained, where does management feel improvements could be made?

Although the issue of least cost was not addressed directly, the respondents did discuss areas where improvements in the respective inventory management systems could be made. At WPMC, a desire for more ad hoc queries and user interface were mentioned. The respondents at KMC stated that, as the system is more financial-based than inventory, it does not respond well to hospital inventory-specific factors, such as fluctuations in item demands and the need for tracking both stocked and non-stocked items with multiple storage locations. The respondents at Evans stated that the inventory management system needed to be on line, rather than batch processed, and should be capable of providing ad hoc queries and specific reports.

Specific Research Question. With several inventory management systems currently used by DOD and civilian

hospitals, can one method be found which would standardize procedures and minimize costs?

This research concluded that, in fact, each of the three hospitals studied uses the same basis for management of inventories: EOQ. Although there may exist several automated inventory management systems, the core which is responsible for setting stockage levels and reorder points is identical.

The majority of individuals interviewed expressed a concern for the lack of responsiveness of their specific exterior automated system, but no respondents discussed a need for a different basis for the management of inventories. The major complaint for the three systems studied was that the systems needed to provide management specific inquiries. With this capability, reports and ad hoc queries would be both on line and real time.

This research supports the conclusion that EOQ is a method which is capable of standardizing procedures across DOD and civilian hospitals.

Recommendations

Hospital inventory management systems offer a variety of areas for further research. Based on the conclusions of this research effort, more extensive studies are needed to determine if a DOD-wide inventory management system is a viable alternative. This topic of research could be a

follow on study, using this thesis as a foundation for the method of comparison, or as a source of existing systems which could be used in a comparative analysis of a greater number of hospital inventory management systems. In order to determine if a DOD-wide inventory management system is a viable alternative, further research on a larger number of DOD hospitals would be helpful. In addition, inclusion of US Navy hospitals could prove beneficial.

A second area for further research is a cost comparison of one EOQ-based system against another. This would provide another foundation by which two or more inventory management systems could be compared with respect to costs minimization.

Summary

As the Department of Defense budget continues to decline, the military services will be forced to cut costs and operate more efficiently in every respect. This will include the provision of medical supplies to customers within the hospital environment. The benefit of this research effort is that it can serve as the foundation for further researchers attempting to determine: 1) where cost savings can occur as a result of improving efficiency and effectiveness; and 2) whether standardizing inventory management across DOD healthcare activities is possible.

Appendix A: Questionnaire

Dear Fellow Professional:

Enclosed is a questionnaire for individuals working with hospital inventory management systems. You are part of a sample of hospital employees chosen to participate in this research.

This research is important to providing insight into inventory management systems currently used by hospitals. This questionnaire was distributed based upon the need for a comparison of inventory management systems at a US Army hospital, a US Air Force hospital, and a civilian hospital. You were selected from within those parameters to participate in the research. I will be combining your responses with those of other logistics professionals, and will ensure the confidentiality of your answers.

Your participation in this research is necessary to determine if a more efficient or effective inventory management system is available for hospitals to use. I request that you review the attached pages to familiarize yourself with the questions which I will be asking you. I will be contacting you telephonically in the next two weeks to schedule an interview appointment at your convenience.

Thank you for your cooperation and support of this research. If you would like to receive a summary of the questionnaire results, you may inform me at the time of our interview.

Sincerely,

Karen A. Lemay
Captain, Medical Service Corps
Graduate Student, Information
Resource Management, AFIT

BACKGROUND

The following questions relate to your background and your current position within the area of health care logistics.

1. What is your current position?
   What are your specific responsibilities?

2. If applicable, how many employees do you supervise?

3. How long have you been in this position?

4. How long have you been employed by this hospital?

5. If applicable, what other positions have you served in?

6. Have you had any other experience with inventory management or other inventory systems?
   If yes, what were your responsibilities and level of knowledge?

CURRENT INVENTORY MANAGEMENT PRACTICES

The following groups of questions relate to the inventory and inventory management systems currently in use at your hospital.

7. What is the bed capacity of your hospital?

8. What is the total dollar inventory for your hospital?

9. Do you know what an inventory turnover rate is?

10. What is your hospital's inventory turnover rate?

11. Can you describe the current inventory management system used at your hospital?

12. Has your hospital always used the current system?
    If no, what other system was used?

13. Why was the system changed?

14. Do you think the current system is better than the previous one?

15. Is there any area within the current inventory management system which you feel needs improvement?
    If yes, what is that/are those area(s)?

16. Are you familiar with any other inventory management systems?

If yes, would one of those systems perform better for the specific needs of your hospital?
Which one?

17. If you are not familiar with any other inventory management systems, can you describe what the ideal system would do for your hospital?
Do any of the inventory management systems described by the interviewer provide the changes necessary to improve your inventory management procedures?

18. Is your hospital known for any unique specialties?
If yes, what is it/are they?

19. Do these specialties cause an increase in demand for related medical supplies?
If yes, do your current inventory management procedures provide adequate levels of these supplies?
Do you have a listing of these supplies that show an increase in demand?

20. How do you measure efficiency with respect to your inventory management system?
What is considered 100% efficient?
What is an acceptable level?

21. How do you measure effectiveness with respect to your inventory management system?
What is considered 100% effective?
What is an acceptable level?

22. Who determines the standard by which the acceptable level is measured?

23. Is the customer involved in the measurement of the acceptable level for efficiency and/or effectiveness?
If yes, can you describe the customer's involvement?

Appendix B: Wright-Patterson Medical Center Summarized Responses

Background Information

The responses obtained from Question 1 through Question 5 have been displayed in Table 2, page 44.

Question 6. Have you had any other experience with inventory management or other inventory systems? If yes, what were your responsibilities and level of knowledge?

-Yes. I had three years experience in another Air Force facility in Germany. Additionally, I have spent 8 months working on a comparative study of Air Force inventory management systems and civilian hospital inventory management systems.

-Not in the military. I was an assistant store manager in retail before, but nothing with medical.

-Before the service, I managed a grocery store. The company had an inventory team to count, but ordering was my responsibility. I have been in this field for 15 years, so most of my experience is related to medical.

-The Air Force has been using EOQ for as long as I can remember. But, I have worked in satellite positions that have used precursors to the current system. I have been in medical equipment management most of the time.

-Yes. I worked in medical logistics as the NCOIC, and was responsible for inventory management.

-Yes. I have spent 8 years in service, with 6 years in base supply. Those positions have been centered around inventory management and special assets management, such as weapons, mobility bags, and risk kits.

Current Inventory Management Practices

The combined responses from the interviewees are listed by question number below.

Question 7. What is the bed capacity of your hospital?

-245 operating beds. Typically, our census ranges from 150-200.

-300.

-325.

-Expandable to 320 beds.

-About 250 beds.
-About 300.

Question 8. What is the total dollar inventory for your hospital?

-$21 million annually for our medical operating supplies.
-$1.8 million, with about one month on hand.
-We maintain about $3.5 million on hand and in transit. Close to $2 million is in transit, with about $1.5 million on hand, depending on the pipeline.
-We have about $1 million stock on hand, with about $3 million on order, in transit, and on hand.
-The total dollar inventory for Central Processing and Distribution (CP&D) is about $150,000.
-About $20 million.

Question 9. Do you know what an inventory turnover rate is?

-Yes.
-Yes.
-Yes.
-Yes.
-Yes.
-No, not exactly.

Question 10. What is your hospital's inventory turnover rate?

-11 to 12 times per year.
-11 to 12 times per year.
-Our inventory turns about every one and one-half to two months.
-We have two to two and one-half months on hand, and our stocks are rotating through at least that often.
-In CP&D, we turn our inventory about 11 times per year.
-I don't know.

Question 11. Can you describe the current inventory management system used at your hospital?

-The Air Force inventory management system is based on the MEDLOG computer system. The foundation for the system is historical consumption data maintained by the computer. Economic order quantities (EOQ) are based on dollar value and pipeline history. The safety level is also determined by the computer. We have some capability to intervene

manually and change items such as pipeline times and sources. 85%-90% of the 6,000 lines are under the control of the computer.

-It is a modified ABC type of inventory management system. The computer system classifies items by annual usage and dollar cost expenditure. They are then placed in one of six categories. Based on which category it is in, that determines the Air Force usage of EOQ. We maintain a lower safety level and things of that nature for high turnover/high cost items.

-The Medical Materiel Management System. This includes inventory control and requisitioning. We have the authority to restock recurring items in this warehouse, and therefore, act as a wholesaler. We are authorized to stock what the customer needs, based on demand history. Demand history is retrievable for the past 12 months.

-EOQ. That is the system we use.

-In CP&D, we use a tri-service, tri-logistics computer system. Based on consumption, it sets levels, reorder points, and gives weekly requirements lists for activities to be used in reordering. The computer supports medical supply records, and provides the capacity to receive, issue, and track costs.

-No, I don't feel that I know what it is, and would not feel comfortable answering that.

Question 12. Has your hospital always used the current system? If no, what other system was used?

-This system has been in use since 1969, but they have used different computer platforms. There have been revolutions in that system. There is more data, more responsive computers, and it is no longer a batch system processed on a base mainframe. We now have real time interface with a minicomputer dedicated to our applications. The basic formulas for EOQ determination have stayed the same.

-I know it has for the last 7 to 9 years.

-About 20 years ago, the system was manual. This system is Air Force wide. Currently, it is an on-line system that has been in place for 2 to 5 years. Prior to this, we had a punched card system with batch processing. The advantage to this system is that people move in the Air Force, and they will know the system when they arrive at a new duty station.

-The Air Force, since I can remember, has always used EOQ calculated with safety levels and pipeline times. The formula has changed drastically with the conversion to the different systems.

-CP&D has been in existence for about two and one-half years. We previously used a civilian company's inventory

management system. When the tri-logistics system was developed, the other system was replaced. Prior to the civilian system, it was a manual system.

-I think they have always basically used the same system. It has used different computer systems, but the basic supply philosophy has been the same. It has just evolved.

Question 13. Why was the system changed?

-Enhancement. The IBM punched card system was time consuming, and not easy to update. Information processing with the current system is much better.

-Because the Army, Navy and Air Force went to a tri-service program. They had no choice in the change.

-I think the same philosophy has always been there, but there have been changes to hardware and software. In those terms, the system hasn't changed. There are just greater opportunities for more power and more speed.

Question 14. Do you think the current system is better than the previous one?

-The current system is quite good, given that the military operates under certain constraints. We warehouse and have a larger volume of due-ins than you would find in a civilian hospital.

-Yes, much better. Some things, such as accountability, inventory, etc. (the basic concepts) haven't changed. The tools have.

-The current system is better. It is easier to correct errors. It has made things better. The older system used batch type procedures.

-No. The previous system had better reporting and ad-hoc query capability.

-I never used the previous computer system. I've only used the new one.

Question 15. Is there any area within the current inventory management system which you feel needs improvement? If yes, what is that/are those areas?

-I am not fully satisfied with its capabilities. It is not as flexible and powerful for performing database queries. We would like to extract specific data for analyses, and the system is not designed for that. My second concern is that the system is designed to carry out an Air Force policy, which might be becoming outdated. The future can lead to more responsiveness. There are studies underway to transfer responsibility for transportation of

supplies from the military to UPS, who can provide next-day delivery. Additionally, requests for supplies could be transferred directly to the Defense Personnel Support Center (DPSC) through Electronic Data Interchange (EDI) from our computers to the vendors computer, eliminating some of the time delays.

-Yes, I think there are a lot of areas that are prime targets for improvement. The biggest area is within the computer systems, and the lack of decision support information that they provide the materiel manager. The system will not allow for ad-hoc reporting and extracting data you might want. It is not a user-friendly system. It is very hard wired. Another area is the handicaps placed on us to abide by the Federal Acquisition Regulation (FAR). There are the contracting requirements, or obstacles, that slow us down. The third area would be in Just-In-Time services. Our computer won't accept a Just-In-Time system. It is going to tell us when to order and how much to order.

-There are system limitations which need improvement, such as storage. This system can only take one storage code. In the newer system, multiple storage locations will be allowed. This is why things are in stock number sequence.

-The system is working for the way the system is designed. It would be better if we could set everything up on contract the way a civilian hospital does. I like JIT and BPA, Blanket Purchase Agreements.

-The current system needs better report capability. There are reports that we don't get which hurt us, such as fill rate and monthly issues by item. We don't really have the report capability of the previous system.

-You have to always say there is room for improvement. Customer relations have improved with the creation or expansion of customer service. If I look at base supply and compare it to medical supply, base supply has a research section that I like. They research out and find what the customer needs. There are reasons for that, but still I like that about base supply. I think we need to upgrade the computer system, and I realize that is being worked on.

Question 16. Are you familiar with any other inventory management systems? If yes, would one of those systems perform better for the specific needs of your hospital? Which one?

-Yes, stockless inventory management. I would be very reluctant to use this system, as this means transferring responsibility for inventory management to a contractor. In the military, you must be able to respond to other concerns, such as flight line accidents, military disasters, and

deploying soldiers on short notice. I don't think we can fully rely on a contractor to provide that kind of service. Moreover, many of the War Reserve Materiel (WRM) items that we manage are expiration dated and are used in peacetime. By using the type of inventory management system we are using now, it enables us to rotate expiration dated WRM items. I would expect to see us using the same kind of safety level/EOQ based reorder point that we use today, but tailoring it for much shorter pipelines, much shorter delivery times and much more responsive deliveries within the hospital.

-I have not worked with any.

-Very few. I have read a few, but I am not qualified about the other ones.

-Not really, just the Air Force systems. I haven't worked with any others.

-No, just what has been mentioned.

-The standard base supply system. No, I can't answer that. Right now, we are so integrated into this one, I don't think we can change. You have to have that continuity within the service.

Question 17. If you are not familiar with any other inventory management systems, can you describe what the ideal system would do for your hospital? Do any of the inventory management systems described by the interviewer provide the changes necessary to improve your inventory management procedures?

-The current system is good, especially if it can be fine-tuned and modified. It does a lot. It establishes and calculates the EOQ and the reorder point, based upon which of the six categories it is in. The concept of the basic system is not bad; you just can't interface with it very much. Having an interface to track with other computer systems within the hospital for workload usage would be helpful.

-The basic system is good, but it needs modifications. We are looking at a new computer system, especially enhanced hardware.

-JIT. This would cut down on warehouse space requirements, and eliminate having excess stock on hand, due to lengthy pipelines. I would like to see base contracting out of the picture, and take on those responsibilities ourselves.

-The ideal system would have report capabilities for instantaneous ad-hoc queries on any item, daily reports of activities as related to the medical logistics system, and be more user-friendly. Most of the concerns deal with

computer interface and computer support that we get or don't get.

-We have the basis for all of it within our own system. It is a matter of adjustments.

Question 18. Is your hospital known for any unique specialties? If yes, what is it/are they?

-We are one of two hospitals in the Air Force to have a Clinical Hyperbaric Chamber. We also conduct interoperative radiation therapy.

-Yes, hyperbaric medicine, cardiovascular surgery, and interoperative radiation therapy.

-As a medical center, we carry as many specialties as possible.

-I'm not sure.

-Open heart surgery.

-Sure. Within the Air Force, we have either the first in a specialty or share that with maybe one other hospital. Hyperbaric medicine and Magnetic Resonance Imaging.

Question 19. Do these specialties cause an increase in demand for related medical supplies? If yes, do your current inventory management procedures provide adequate levels of these supplies? Do you have a listing of these supplies that show an increase in demand?

-Hyperbaric medicine probably results in a few more specialized supplies, although I don't think it's a big impact. Yes, the current system provides adequate supplies.

-Cardiovascular is difficult. The other two are not. Yes. These supplies are more closely monitored, due to cost and criticality. No, I don't have a listing of these items.

-Yes, but our inventory control system can handle it.

-Medical Centers are the only activities authorized to have specialties. No, our current inventory management procedures don't provide adequate levels of these supplies. We stock about 5400 lines, and our stock status report states that about 2100 lines have problems. Some of the reasons for these may be that the customer requested the wrong item initially, or has not ordered them after the first request. Also, the initial estimation of quantity usage may have been wrong, which leaves us with excess stock. Quarterly training classes for customers are trying to be implemented.

-Not on our supplies.

-Initially, yes. They sure do. I think that levels out. Yes, they do. Certain factors have to be in there and those factors have to be evaluated in the right way. There

is always some human input there and there is always some things that can get in there and skew it up.

Question 20. How do you measure efficiency with respect to your inventory management system? What is considered 100% efficient? What is an acceptable level?

-Efficiency is measured by turnover rate, what percentage of your inventory is stratified across excess, and the fill rate. Also, we should ensure orders equal sales. It is the ratio of total investments in inventory required to produce a particular volume of output in sales. We would be 100% efficient if we could reduce the cost of investments to zero which are necessary to produce outputs required to be provided to the medical community. There is not an absolute goal, that once achieved, is always acceptable. In the Total Quality Management arena, your efficiency should continually be improving over time without a loss of effectiveness in providing what is needed for patient care.

-Efficiency is measured by turnover; fill rate, which is the most common Air Force wide, being the percentage of times you can provide any quantity of item requested; economic retention, is it cheaper to keep the item than to get rid of it; excess quantities; and destructions. 100% efficient would be nothing reported as excess, no destructions, no economic retentions, and a very good turnover rate. That wouldn't be good for the hospital because our fill rate would be much less than 95%. The acceptable level is a 95% fill rate.

-It is managed by reports, such as the Medical Stock Status Report. This report lists identified items which are outside the inventory management parameters. The computer analyzes what is on hand, how it is being used, and humans make decisions. A 95% fill rate is the acceptable level.

-It is measured by fill rate. A 100% fill rate would be 100% efficient. The Air Force standard is 95%. The less stock on hand to maintain the fill rate, the better.

-We have no way for CP&D. Medical logistics measures 100% efficiency by fill rate, but we have no capability.

-I guess you could look at a lot of different factors. I would look at my fill rate. Also, you don't want to be holding a lot of inventory. You can't have that. No, I don't know what someone considers 100% efficient. A 95% fill rate is the Air Force's acceptable level.

Question 21. How do you measure effectiveness with respect to your inventory management system? What is considered 100% effective? What is an acceptable level?

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Appendix D: Evans US Army Community Hospital Summarized Responses

Background Information

The responses obtained from Question 1 through Question 5 have been displayed in Table 2, page 44.

Question 6. Have you had any other experience with inventory management or other inventory systems? If yes, what were your responsibilities and level of knowledge?

-Yes, I have been a medical Supply Officer on two occasions, one in manual accounts and one in automated. In addition, I have also served as a Chief, Logistics Division. During an assignment in Europe, I was responsible for the systems for the command, to include AMMEDPAS, medical supply, and medical maintenance.

-No, just with the manual system. All the rest has been in SAILS.

-No, just with SAILS at this hospital.

-Yes, I was a Division Medical Supply Officer (DMSO) for a manual system. We had a 400 line inventory.

-Yes. I have worked with MEDSTOCK, CP&D, AMEDDPAS, and SAILS.

Current Inventory Management Practices

The combined responses from the interviewees are listed by question number below.

Question 7. What is the bed capacity of your hospital?

-195 beds.
-195 beds.
-195 beds.
-195 beds.
-I don't know.

Question 8. What is the total dollar inventory for your hospital?

-$4 million, which includes PWRS, Prepositioned War Reserve Stocks.

-approximately $4 million.

-$4.5 million.
-About $4.5 million.
-About $4.5 million, including PWRS, Prepositioned War Reserve Stocks.

Question 9. Do you know what an inventory turnover rate is?

-Yes.
-Yes.
-Yes.
-Yes.
-Yes.

Question 10. What is your hospital's inventory turnover rate?

-I do not know the exact figure.
-Every 90 days. SAILS determines this for us.
-Our inventory should turn over every 90 days. It is geared to do that.
-It doesn't come out on reports. They look at it from different angles. We shoot for a 1:1 ratio on inventory turnover. We carry 90 days of supply and that turns over pretty equally.
-No, I don't actually know what the inventory turnover rate is.

Question 11. Can you describe the current inventory management system used at your hospital?

-SAILS, which stands for the Standard Army Intermediate Level Supply System. It is operated by other than the Army Medical Department. SAILS is not a good system; it is horrible. The system is often updated for other activities, which causes us to bomb out. The basis of the system is EOQ. Only five Army Medical Activities are still using SAILS today. We are in the process of changing to TAMMIS, the Theatre Army Medical Management Information System.
-SAILS. It computes and generates everything that is needed.
-Currently, we are using SAILS. This system is also used to compute order ship time to determine our reorder points.
-SAILS is the system we use. It is not a good system. It is automated, which is better than a manual system, but it is non-specific. It handles all classes of supply, and is not good for class VIII, or medical, supplies.
-SAILS is the current system, but we are getting ready to switch to TAMMIS. SAILS is the standard Army system that

has all material categories, not just medical. It is a batch processing system, and has everything in it.

Question 12. Has your hospital always used the current system? If no, what other system was used?

-We have used SAILS for 12-14 years. Before that, the system was manual.
-No. They used to have a manual system with stock record card sets for each line item.
-Before SAILS, it was a manual system. SAILS has been in use for about 10 years.
-Yes, except for the manual system before that. We converted in about 1980.
-I believe. It has been in existence for about 10 years. Before that, it was manual.

Question 13. Why was the system changed?

-For automation.
-Automation was the way to go. It was the new wave of the future.

Question 14. Do you think the current system is better than the previous one?

-Yes. A manual system wouldn't survive in today's environment.
-Yes.
-Yes.
-Yes.
-Yes.

Question 15. Is there any area within the current inventory management system which you feel needs improvement? If yes, what is that/are those areas?

-Yes. Data query capability is poor; the ability to design and produce reports is limited. This impacts on the ability for the Army Medical Department to conduct business. SAILS is to a great extent a batch system, which is processed at a remote location. This complicated of a system has a high error rate.
-No. I feel that SAILS does the job quite well.
-There are a few. The steps you have to take to input or complete a job are very time consuming. The excess program within SAILS needs improvement in how the system manages it. It is a poor system for management because it often gives you one day to compute excess; otherwise, the system will revert back, transfer the excess into operating

stocks again, and the procedure for reporting the excess starts over again.

-Yes. It is not an on-line system. Often, cycles don't run and reports are late. The Directorate of Logistics (DOL) at Ft. Carson inputs our information into the SAILS system. St. Louis is the regional data center where the information is sent. At St. Louis, it is batch processed, and often we don't receive our daily runs. The biggest problem is that too many people's hands are in the pot. SAILS is not responsive enough. It is also not specific enough to cover the needs of Class VIII medical supplies, such as shelf life, expiration dates, and life or death medical needs.

-Yes. It should be more on-line and more responsive. With SAILS being a standard Army system, we have a regional data center in St. Louis. It is an Army Materiel Command center. The system would be more timely if it were on-line.

Question 16. Are you familiar with any other inventory management systems? If yes, would one of those systems perform better for the specific needs of your hospital? Which one?

-Yes, TAMMIS. It is an Army Medical Department system. The possibility of designing local reports is unlimited. It is an on-line system which has a very quick response. This system will be the only one used in both TO&E and TDA Army medical activities.

-Yes. AMMEDPAS and the bar code system.

-I am familiar with MEDSTOCK and TAMMIS. I have read a lot about them, but not worked with them. Yes, the TAMMIS system will be a good system for us. It is an on-line system, not depending on the post level for batch processing.

-Not intimately, but I am somewhat familiar with MEDSTOCK (Medical Stock Accounting System). Yes, TAMMIS will be an in-house system, with only a few people interfacing with the system.

-Only military ones, and only as an observer. They are basically the same.

Question 17. If you are not familiar with any other inventory management systems, can you describe what the ideal system would do for your hospital? Do any of the inventory management systems described by the interviewer provide the changes necessary to improve your inventory management procedures?

Question 18. Is your hospital known for any unique specialties? If yes, what is it/are they?

-No, we are just a MEDDAC, Medical Department Activity.
-I don't think so.
-No.
-Not really. We do a lot of orthopedics.
-No, not really. We have a lot of retirees and deliver a lot of babies.

Question 19. Do these specialties cause an increase in demand for related medical supplies? If yes, do your current inventory management procedures provide adequate levels of these supplies? Do you have a listing of these supplies that show an increase in demand?

Question 20. How do you measure efficiency with respect to your inventory management system? What is considered 100% efficient? What is an acceptable level?

-2 ways. The traditional method is to compare 0 balances to costs of holding inventory. The second method is the number of complaints from the Comptroller, which is what I use as a measure. There is no level that is 100% efficient. As long as the boss isn't beating me up, then that is an acceptable level.
-SAILS does that by computing the demand satisfaction rate. 100% efficient is when we have everything requested within our inventory. Sometimes we have 0 balances. The acceptable level is 90%-100% for demand satisfaction.
-We measure that by excess levels (the less excess, the more efficient the system). Also, correct reorder points and correct order ship times help measure efficiency. If your reorder points are too low, you won't have enough stock on hand. Nothing requires us to be 100% efficient. Yes, there is an acceptable level which is measured by demand accommodation. Health Services Command guidelines stipulate 55%-85% to be an acceptable level.
-Some areas to look at are excess management, due-outs to customers, due-ins to our inventory, the quantity of local purchases being made, and the quantity of supplies in transit. No, there is not a level which is 100% efficient. Some of the measures of the acceptable level are that not more than 10% of inventory on hand should be excess. Also, you could look at inventory accuracy. You should have greater than 98% accuracy on inventory. In other words, not more than 2% of lines should have greater than a $30.00 variance in extended values.
-Health Services Command and Army Regulation 40-61 set out the rules by percentages through the demand accommodation rates. Being 100% efficient would be to have everything the customer wants. The acceptable level is a

range of 70%-85% demand accommodation. You don't want to have 100% because you get overstocked.

Question 21. How do you measure effectiveness with respect to your inventory management system? What is considered 100% effective? What is an acceptable level?

-Again, there are two ways. The traditional method is through 0 balances, as well as the demand accommodation and demand satisfaction rates. The second method is through complaints received from customers. The boss cares about customer satisfaction. If customers complain, that area needs attention. There is no level that is 100% effective. The acceptable level is very subjective and qualitative. Regardless of how good a job you do, if you don't have good public relations, then you aren't worth anything.

-Again, SAILS computes this for us by determining the demand accommodation rate. 100% effective would be when the depot provides all supplies needed in a timely manner so that local purchases are not required. The acceptable level for demand accommodation is 65%-85%.

-The most important measure is 0 balances. If they are kept to a minimum, you are doing an effective job. 0 balances are at a minimum if you have less than 8% of total lines at 0 balance. 100% effective is unreasonable. Demand satisfaction is a measure of effectiveness, and Health Services Command stipulates that level to be 90%-100%.

-There is more than one measure used. Demand satisfaction rate, demand accommodation rate,and 0 balance rate. Actually, these three measures tie in to both efficiency and effectiveness. If you run an efficient system, you should have low 0 balances. Inventory accuracy applies too. To be 100% effective, there are management objectives, which are specified percentages which we should be meeting. These are 75% for demand accommodation, and 95% for demand satisfaction. The acceptable level is the management level, which is a range of the percentage which we should be meeting. For demand accommodation, you should accommodate a request 65%-85% of the time. For demand satisfaction, the management level is 90%-100%.

-The measurement used is demand satisfaction. To be 100% effective would mean that you must meet all requirements, but I think that's unreasonable. The acceptable level is to have 5%-8% zero balance variance on our stocked lines.

Question 22. Who determines the standard by which the acceptable level is measured?

-Two groups of people. The first is the boss, whether that be the Hospital Commander, the Deputy Commander for Administration, the Deputy Commander, Clinical Services or the Chief, Nurse. These individuals lean on me when I need to be. The second is the customer. If they aren't happy, then I'm not doing my job properly.

-Health Services Command, our major command, and the Department of the Army.

-Health Services Command, and the Department of the Army.

-The Department of the Army and Health Services Command. Health Services Command uses Army Regulation 40-61 as their guidance, and most of the regulations are pretty reasonable for operating your medical account.

-Health Services Command sets the standards by which we operate through Army Regulation 40-61.

Question 23. Is the customer involved in the measurement of the acceptable level for efficiency and/or effectiveness? If yes, can you describe the customer's involvement?

-Yes. The customer is the be all and end all. They determine everything.

-No, the customer is not.

-No, they aren't.

-Indirectly. They don't have any say in the statistic we produce. Based on their requirements, we determine our performance indicators, such as demand accommodation and demand satisfaction. The customer's requirements could change month by month, and the Medical Supply Officer would either meet or not meet the performance indicators.

-They are somewhat. They must be aware that when they get supplies from us, they must do it in a consistent manner. The customer must understand how their demand requests affect us. It is difficult to build seasonal demands into an automated system.

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Vita

Captain Karen A. Lemay was born on 19 February 1956 in Norwood, Massachusetts. She graduated from Foxboro High School, Foxboro, Massachusetts in 1974. In 1977, after three years of full-time employment, she entered Michigan State University. In September of 1980, she transferred to Kean College of New Jersey, where she studied Biology. In June 1983, she graduated with a Bachelor of Arts, and was commissioned as a second lieutenant in the United States Army Medical Service Corps. After completion of the Army Medical Department (AMEDD) Officer Basic Course and the Medical Logistics Management Course in November, 1983, CPT Lemay began an assignment as a Health Materiels Management Officer at Ft. Hood, Texas. In October, 1984, she was reassigned to the US Army Medical Department Activity, Ft. Monmouth, New Jersey, where she served in a variety of positions until September, 1987, when she was reassigned to the Logistics Division, Academy of Health Sciences, Ft. Sam Houston, Texas.

During this tour, CPT Lemay obtained a Master of Arts in Health Services Management and attended the AMEDD Officer Advance Course. She entered the School of Systems and Logistics, Air Force Institute of Technology, in May 1990.

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13 ABSTRACT *(Maximum 200 words)*

The purpose of this thesis was to determine if one method of inventory management would standardize procedures and minimize costs for DOD and civilian hospitals. This was accomplished by conducting a comparative analysis of inventory management systems used at Wright-Patterson Medical Center, WPAFB, Dayton OH; Kettering Medical Center, Kettering OH; and Evans US Army Community Hospital, Ft. Carson CO. The literature review examined various inventory management methods used for both general and hospital-specific inventories. The measurement instrument developed to gain information on the specific inventory management systems used at the three hospitals was an open-ended questionnaire. The conceptually clustered matrix was selected as the methodology to conduct the analysis. The thesis concluded that, although different automated systems were used at the three hospitals studied, the basis of each inventory management system was Economic Order Quantity (EOQ). The changes desired by all the individuals interviewed were in the user interface to the automated systems, not in the method by which inventories were maintained. EOQ is a satisfactory method of inventory management for DOD and civilian hospitals.

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